LOW VOLTAGE POWER GRID DETECTION

The Wireless World AND RADIO REVIEW

4D

The Paper for Every Wireless Amateur

Wednesday, December 3rd, 1930.

A coil for every Radio Circuit

COLVERN RADIO

Advt. of Colvern Ltd., Mawney's Road, Romford.

"EKCO"

PLUG IN — THAT'S ALL

Write for Free Literature on "All-Electric Radio" and details of Easy Payments to E. K. Cole, Ltd., Dept. W, "Ekco" Works, Southend-on-Sea.

ALL-ELECTRIC RADIO

"Utility"

Silver Contact Anti-Capacity Switch.

The provision of Silver Contacts in these Switches is designed to overcome all troubles due to oxidisation, etc. Contacts are mounted on Bakelite base and provision is also made for connections by terminals or soldering lugs. Lever operated. One-hole fixing. Nickel plate finish. Dimensions, 2-pole type, 1¾" deep × 2" × ⅞".

W.215/2 2-pole change-over 5/6
W.215/3 3-pole ,, ...6/6
W.215/4 4-pole ,, ...7/6
W.215/6 6-pole ,, ...9/6

"Utility" Guaranteed Components are stocked by the majority of Wireless Dealers, or in case of difficulty may be had direct.

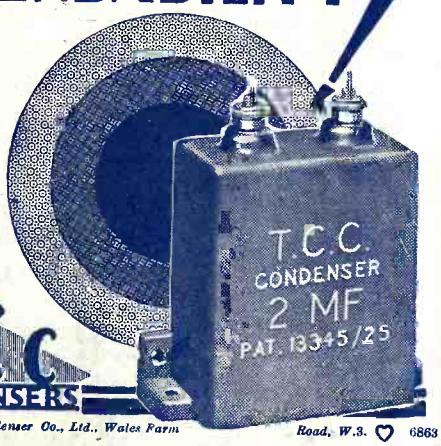
WILKINS & WRIGHT, LTD., "Utility" Works, Holyhead Rd., B'ham

ILLUSTRATED LIST POST FREE.

WIRELESS INSTRUMENTS

DEPENDABILITY

Licensed under design Reg. No. 723271.



T.C.C. CONDENSERS

Advt. of Telegraph Condenser Co., Ltd., Wales Farm Road, W.3. 6863

No. 588. Vol. XXVII. No. 23.

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B T-H

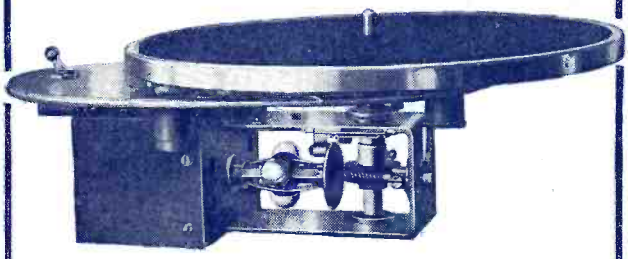
Electric Gramophone Motor

for

Christmas Festivities

Turn your clockwork gramophone into a first-class electrically-operated instrument, by fitting a B.T.H. Electric Gramophone Motor, and hear your favourite melodies and dance music to the best advantage.

Easily fitted—only one hole to cut; will operate from your lighting supply; even speed—never runs down; plays 900 records for one unit of electricity.



NO WINDING—
JUST SWITCH ON!

Costs only £3 - 3 - 0

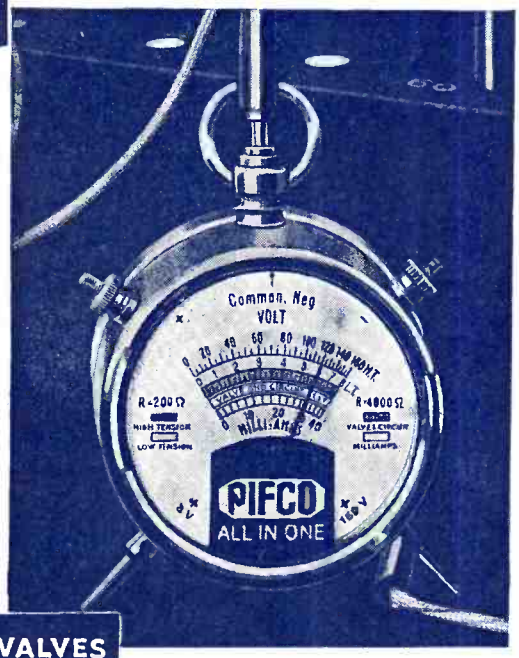
from all high-class dealers.

The British Thomson-Houston Co. Ltd.

ELECTRICAL ENGINEERS AND MANUFACTURERS

Head Office - - - - - - - - - - Rugby
London Office - - - - - "Crown House," Aldwych
Works: Rugby, Birmingham, Willesden, Coventry, Chesterfield

As Easy To Read As Clock Time!



P3

TESTS VALVES
FILAMENT · ·
ANODE & GRID
COMPONENTS
AND CIRCUITS
H.T. AND L.T.
MILLIAMPS
Everything!

HAVE YOUR SET 100% EFFICIENT

Have you ever built a set that wouldn't work? Has a mysterious fault in wiring or component eluded your most thorough search? How many hours have you wasted and how many valves have you burnt out when you have had trouble—how many times have you given up in disgust?

Well, from now on you can say goodbye to all that! The All-in-One Radiometer will test valves components, circuits, batteries, everything—quickly, safely and with absolute certainty.

For 12/6 you can have a wireless expert at your beck and call. You may be a radio fan or the veriest amateur, it matters not a scrap—the All-in-One will help you out. You can be sure of everything before you turn on the juice! The steady readings given on the dial are as easy to follow as the hands on your watch, and the instrument gives perfect accuracy—it has a beautifully finished calibrated mechanism that cannot let you down.

Ask for our Booklet—obtainable through all good wireless dealers, or write to Pifco Ltd., Pifco House, High St., Manchester.

12/6

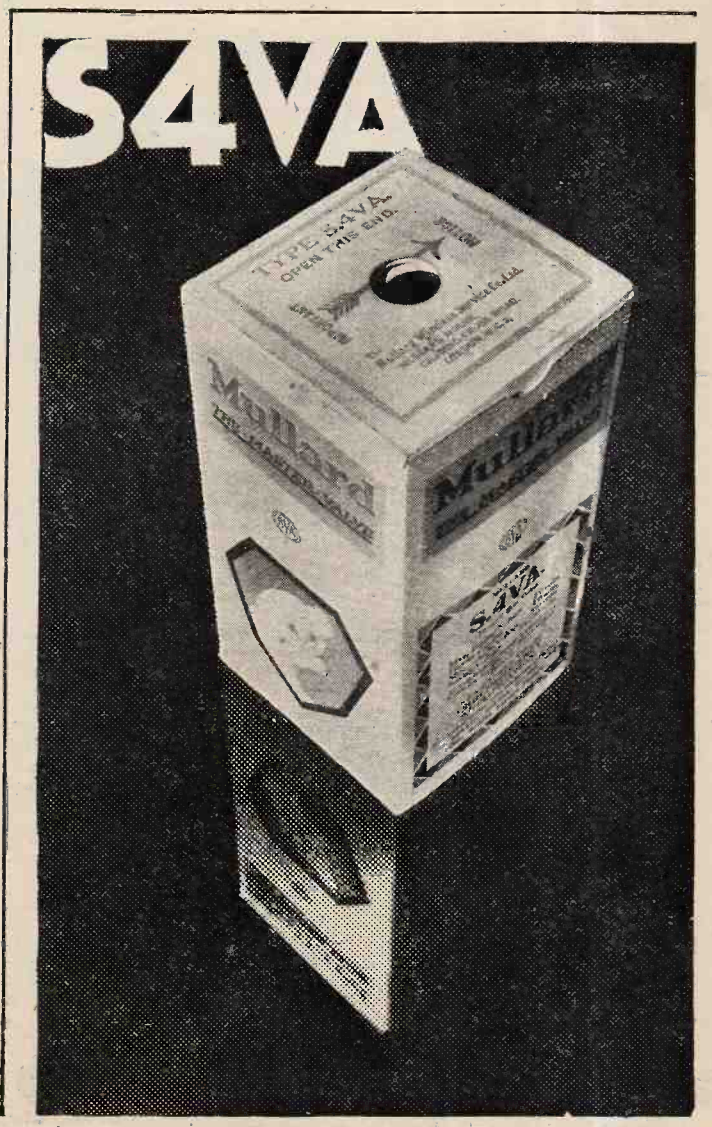
PIFCO ALL IN ONE RADIOMETER

AN OUTSTANDING RANGE OF A.C. SCREENED GRID VALVES

Mullard A.C. types S.4V, S.4VA and S.4VB are indirectly heated screened grid mains valves having amplification factors ranging from 900 to 1,500. In conjunction with efficient circuits these valves make possible stage gains hitherto considered impossible, and definitely set a new standard for H.F. amplification. As with all Mullard indirectly heated mains valves, the rigid and compact design of the electrode system, results in very high performance. From this range of valves a choice of H.F. amplifiers to suit any circuit can be made.

PRICE 25/- each

Mullard
THE · MASTER · VALVE



CHARACTERISTICS

S.4V.

Max. Heater Voltage ...	4.0 volts
Heater Current ...	1.0 amp.
Max. Anode Voltage ...	200 volts
Positive Screen Voltage	75 volts
*Anode Impedance .	909,000 ohms
*Amplification Factor ...	1,000
*Mutual Conductance ...	1.1mA/volt

*At Anode Volts 100. Screen Volts 75. Grid Volts Zero.

S.4VA.

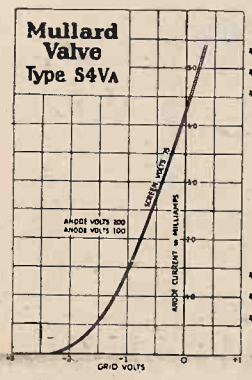
Max. Heater Voltage ...	4.0 volts
Heater Current ...	1.0 amp.
Max. Anode Voltage ...	200 volts
Positive Screen Voltage	75-100 volts
*Anode Impedance ...	430,000 ohms
*Amplification Factor ...	1,500
*Mutual Conductance ...	3.5mA/volt

*At Anode Volts 100. Screen Volts 75. Grid Volts Zero.

S.4VB.

Max. Heater Voltage	4.0 volts
Heater Current ...	1.0 amp.
Max. Anode Voltage ...	200 volts
Positive Screen Voltage	75-100 volts
*Anode Impedance ...	257,000 ohms
*Amplification Factor ...	900
*Mutual Conductance ...	3.5mA/volt

*At Anode Volts 150. Screen Volts 75. Grid Volts −1.

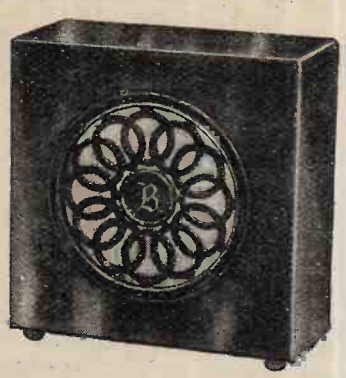


Advt.: The Mullard Wireless Service Co., Ltd., Mullard House, Charing Cross Road, London, W.C.2. Arks.

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

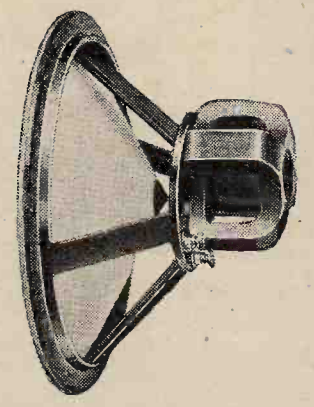
Brown

BRITISH RADIO INSTRUMENTS



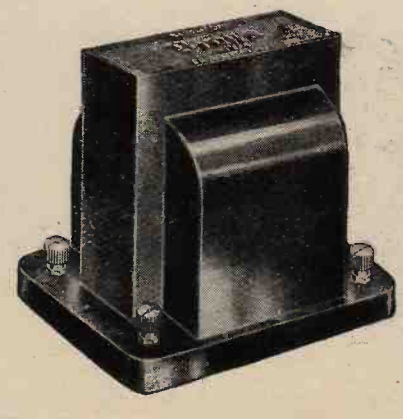
Brown "Peke" Moving Coil Movement

Here is the latest Brown achievement—a new Permanent Magnet Moving Coil Movement for only £4. 4s. The new Brown "Peke" is the result of lengthy research and experiment in the Brown laboratories. It gives real moving coil quality — reproducing the low notes richly and fully, without a trace of artificiality, and the high notes purely and sweetly. Yet its price is only **£4.4s.**



In Handsome Walnut Cabinet

The Brown "Peke" Moving Coil Movement can be fitted to any Receiver. It is also supplied in the handsome walnut cabinet illustrated above. Complete in its case, the Brown "Peke" is a moving coil loud speaker without comparison at its moderate price of **£6.15s.**



Brown Transformer

—a real Precision Instrument

There is no better transformer than the Brown (illustrated here). There are others cheaper, but none that has such a high standard of performance. The constructor who wants the best transformer that money can buy will choose the Brown. N.P.S. curve proves its even response throughout the whole harmonic scale. The transformer is hermetically sealed against dampness in a handsome moulded case. Ratio 3.5 to 1. Type B. Price **17/6**

See the New Brown Super Pick-up and Tone Arm
at your Wireless Dealer's. Gives great volume with even quality of response. Tone arm designed to minimise wear on record.
Price £3 3s.

AS BRITISH AS BRITANNIA

S. G. Brown, Ltd., Western Ave., N. Acton, W.3.

6877

WORKING VOLTAGES OR TEST VOLTAGES?

AN IMPORTANT STATEMENT BY THE TELEGRAPH CONDENSER CO., LTD.

At the present time there is some confusion regarding the most suitable method of indicating Condenser voltages. Some manufacturers, including ourselves, mark their Condensers with their actual *working* voltages. Others adopt the more spectacular method of indicating *test* voltages.

Because test voltages are obviously much higher than actual working voltages, the Condenser buyer may be led to believe that the higher voltage indicates a more efficient and better insulated condenser. This is not necessarily the case.

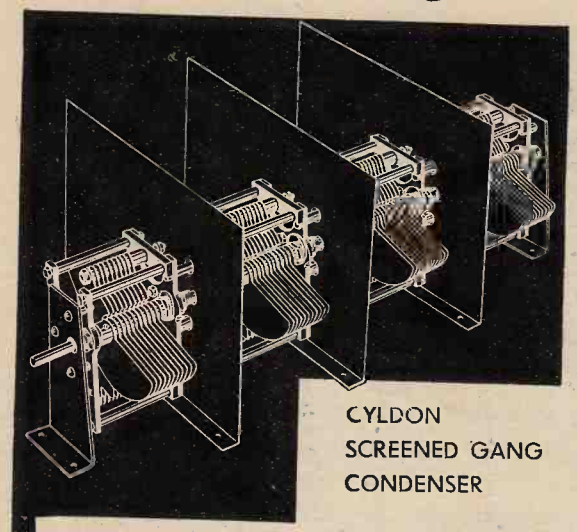
In the past it has been fairly safe to assume that the continuous working voltage of a Condenser was half of its stated test voltage. Unfortunately, this method of grading Condensers can no longer be universally relied upon since it has been found that Condensers of similar capacity and size have been sold stamped with varying test voltages, but with no indication as to the working voltage. (This formed the subject of a statement issued by us earlier this year in reference to condensers of foreign manufacture).

We, therefore, recommend all users in their own interests to see that the Condensers they purchase are definitely marked with their maximum working voltage. This will always be found on "T.C.C." CONDENSERS.

T.C.C CONDENSERS

TELEGRAPH CONDENSER CO. LTD., N. ACTON, W.3

Creators of High Grade Precision Condensers



CYLDON
SCREENED GANG
CONDENSER

STG.95 Twin .0005 30 -
STG.35 Triple .0005 45/6
★STG 45 Four .0005 65 -

★ Specified for the WIRELESS WORLD FOUR. Supplied complete, assembled with special screens.

SYDNEY S. BIRD & SONS LTD. CYLDON WORKS, SARNESFIELD ROAD, ENFIELD, MIDDLESEX. Tele: Enfield 2071 2

CYLDON ALONE GIVES ACCURATE MATCHING

Gang control, adopted for the Wireless World Four, depends entirely for its efficiency upon accurate sectional matching such as CYLDON construction alone can give. Superior raw material skilfully fashioned, many outstanding mechanical features, gauge tested machined parts, precision built, and capacity bridge tested after complete assembly, recommends you to **build with CYLDON** . . . it costs more but its construction amply justifies it. Send for details of full range.

cyldon

FIVE YEARS GUARANTEE

Have you heard The NEW SET ?

The EDISON BELL
ALL MAINS
3

Quality, rather than extreme range, is the feature of this model, and with the unique speaker incorporated, brilliant and truthful reproduction is attained. Enclosed in an attractive walnut cabinet with all connection points concealed at the back, the instrument may also be used as an amplifier of gramophone records in conjunction with a suitable electrical pick-up.

SPECIFICATION.

Circuit.—Detector, resistance coupled L.F. transformer coupled L.F., with super power output valve.

Eliminator.—Built into set, supplying all necessary H.T., L.T. and bias.

Controls.—Single slow motion tuning dial, reaction control, mains switch, wave-length pick-up, change-over switch.

Wave Length.—190-500 and 1,000-2,000 metres controlled by a small switch.

Pick-up.—Sockets provided at back of cabinet controlled by point on wave length switch.

Valves Supplied.—Mazda AC/HL, AC/P and Mullard A.C.064. Rectifier Mullard DW/2 or Philips 1821.

Voltage.—Standard model 200-240 volts, 50-100 cycles, other voltages to special order.

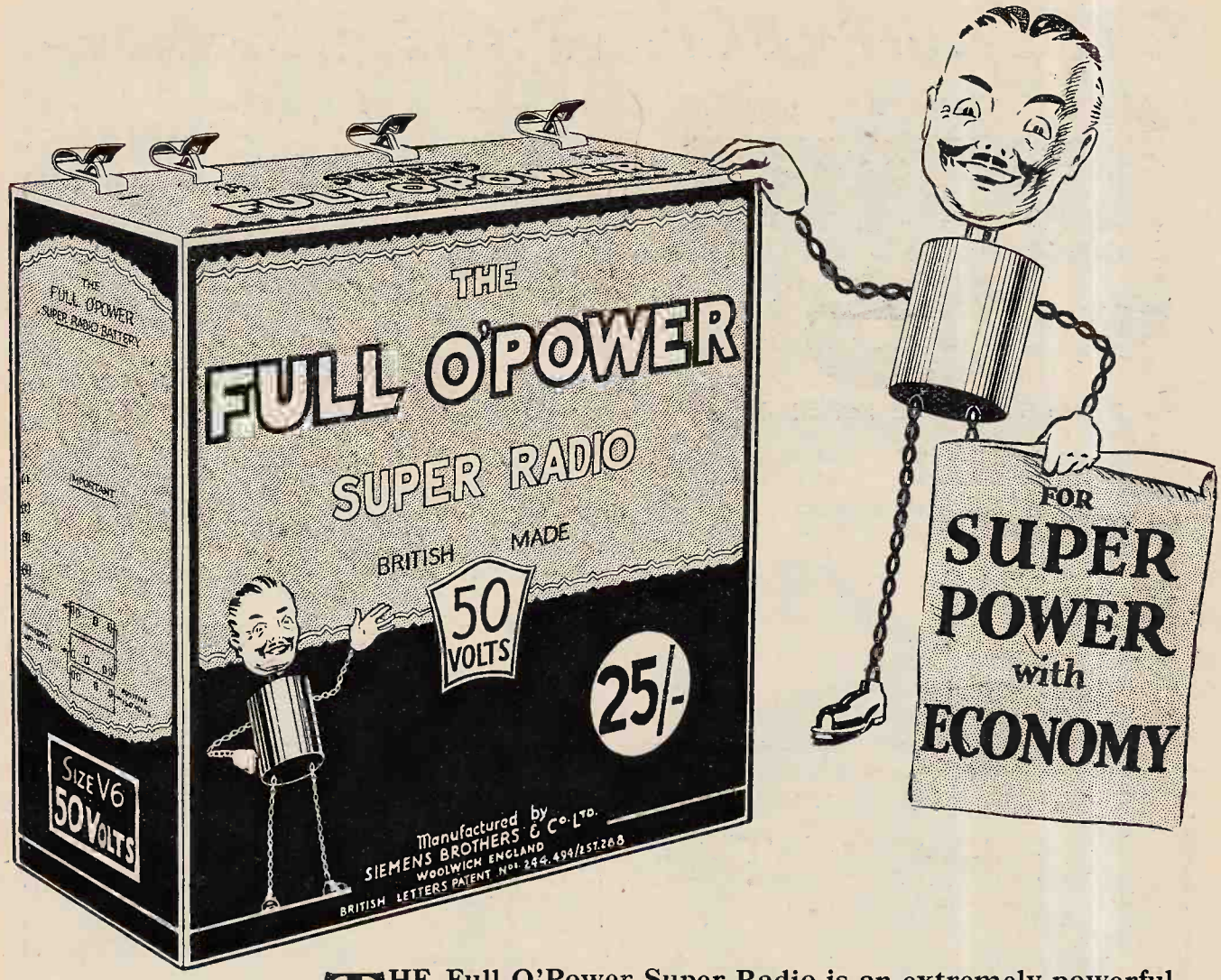
Speaker.—Cone speaker of special design incorporated in cabinet.

Price £19 : 19 : 0 inclusive.

Send for particulars of All Mains Sets.

West End Agents : Keith Prowse, 163, Regent St., W.1.

EDISON BELL, LIMITED,
LONDON, S.E.15, and Huntingdon.



THE Full O'Power Super Radio is an extremely powerful H.T. Battery, capable of maintaining a high standard of quality in reproduction even under heavy service conditions. The Full O'Power principle of construction has enabled it to be considerably reduced in size without any loss in output capacity.

This battery is unsurpassed for the operation of multi-valve sets with Super-Power or Pentode valves in the output stage.

Dimensions : $8\frac{3}{8} \times 3\frac{7}{8} \times 9$ ins. high. *Weight : 15 lbs.*

Write for the Full O'Power Booklet. Full of useful hints and tips. It also contains illustrations, sizes and prices of the complete Full O'Power range. Send for your free copy now.

SIEMENS

FULL O'POWER

THE BATTERY THAT IS DEFINITELY SUPERIOR

SIEMENS BROTHERS & CO. LTD., WOOLWICH, S.E.18. Telephone : Woolwich 1161.

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

For Christmas!

BUY A

WATES

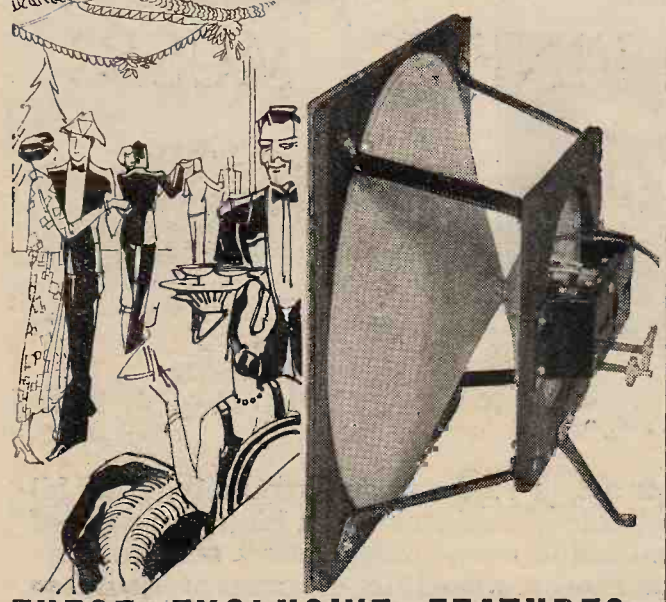
ORIGINAL AND GENUINE

12" Price 11/6
14" Price 12/6

20"

20" Price 17/6

UNIVERSAL DOUBLE CONE CHASSIS



THESE EXCLUSIVE FEATURES ARE FOUND ONLY IN THE "WATES."

(1) SCROLL CUT CONE. This special joint in the chemically treated paper of the cone avoids a direct cut through the sound waves, thereby enabling the cone to respond freely and without distortion, resulting in a purity and fidelity to the original that has earned its reputation for the finest reproducer obtainable.

(2) THE WATES UNIVERSAL BRACKET is an ingenious plate cut to a special design fitted to any of these units:—Blue Spot 66R, 66P, Ormond, Blue Spot 66K, Watmel, Ediswan, Hegra, G.E.C., Lissen, Triotron, Brown Vee, Amplion B.A.2, Loewe, W. & B., Silver Chimes, Growor, Grassman, Tegaf, Six Sixty, Kukoo, without any adjustment or difficulty.

(3) THE UNIQUE SUSPENSION of the large cone is a feature exclusive to this chassis and is a vital contributor to the wonderful results obtained.

Do not be "put off" with spurious imitations—insist on the Wates and enjoy the remarkable reproduction that it achieves.

Obtainable from all Radio dealers. Fully descriptive leaflets on request from:

THE STANDARD BATTERY CO. (Dept. W.W.), 184/188, Shaftesbury Avenue, London, W.C.2.

VOTED THE FINEST ALL-MAINS UNITS AT OLYMPIA

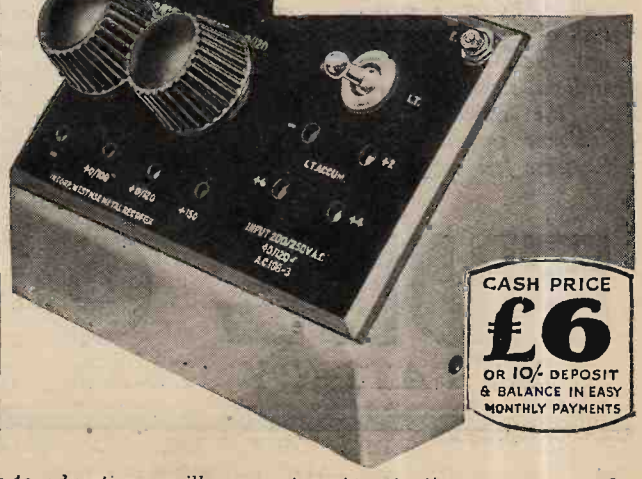
DISCRIMINATING enthusiasts unanimously voted the new "ATLAS" Units A.C. 188 the finest All-Mains Units at Olympia. Placed first in the "Wireless World" Olympia Competition, Model A.C. 188 provides outstanding features. Incorporating this Unit, any Set, Standard or Portable, is converted into All-Mains with the minimum of expense and trouble. A combined H.T. Battery Eliminator and L.T. Trickle Charger, incorporating the Westinghouse Metal Rectifier, A.C. 188 provides, on the H.T. side, 2 variable Tappings, 0/100 and 0/120 Volts, 1 fixed of 150 Volts and gives an output of 150 Volts at 25 m/A. L.T. Trickle Charger caters for 2, 4 and 6 Volt Accumulators. Have All-Mains economy, reliability and convenience for your Set—Ask your dealer for Folder No. 55, or write direct to the makers.

H. CLARKE & CO. (M/CR), LTD.
Old Trafford : : Manchester

MODERNISE YOUR SET WITH

"CLARKE'S ATLAS"

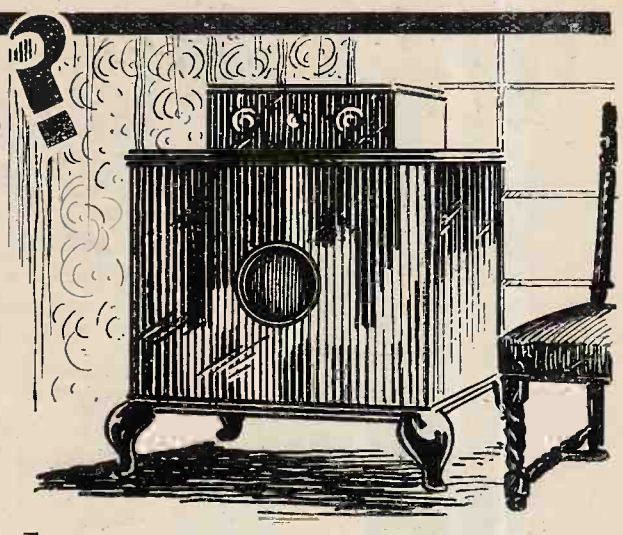
MODEL A.C. 188



CASH PRICE £6 OR 10/- DEPOSIT & BALANCE IN EASY MONTHLY PAYMENTS

Is it worth it?

To go to the expense and trouble of installing a moving coil loudspeaker, with its heavy upkeep costs, and in many cases indifferent performance



When you can hear—

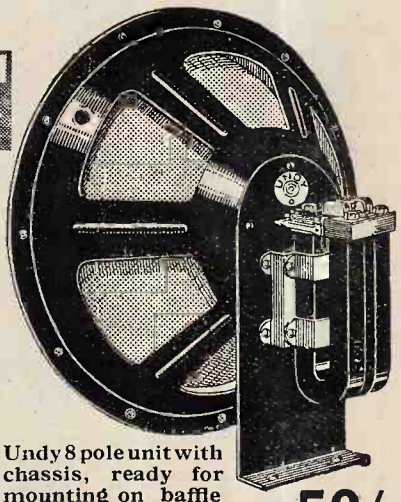
THE WORLD'S FINEST MUSIC

on the

"UNDY"

8 POLE DYNAMIC SPEAKER

Undy 8 pole loudspeaker, in beautiful mahogany cabinet. **70/-**



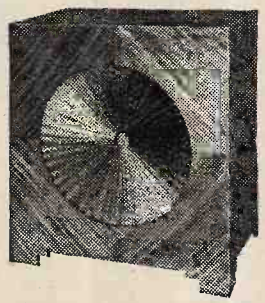
Undy 8 pole unit with chassis, ready for mounting on baffle board or in cabinet. **50/-**

The construction of the Undy 8 pole loudspeaker is a milestone in the development of wireless.

On account of its superior construction it meets the most exacting demands in sensitivity, power and frequency range.

Do not fail to hear this loudspeaker to-day at your dealer's—you will be surprised !

Undy 8 pole loudspeaker, in highly polished walnut cabinet de luxe. **90/-**



Undy 8 pole dynamic loudspeaker, in polished walnut cabinet. The moderate-priced speaker for the most exacting requirements. **55/-**

Obtainable from your usual Dealer.

ASK FOR DEMONSTRATION.

TRIUMPHS OF BRITISH RADIO RESEARCH

Modern compact components that yield positively unequalled results and ensure absolute reliability and lasting efficiency beyond question.

DUAL ASTATIC H.F. CHOKE

Designed after an exhaustive investigation undertaken to overcome energy absorbtion on broadcasting wavelengths, the Dual Astatic Choke is a brilliant example of modern radio research—it is the only H.F. choke that ensures perfect amplification from screened grid valves at all broadcast wavelengths. It entirely eliminates blind spots and absorbtion, and can be mounted adjacent to other components without fear of interaction.

Resistance D.C. 650 ohms.
Inductance 60,000 micro henries.

7/6

The PENTOMITE

The employment of Nikalloy as the core in the Pentomite Filter Output gives astonishingly high inductance with minimum weight and size. It is specially recommended as an output filter choke with the A.C. Pentode valve, and was specially selected as such by the designers of *The Wireless World* "Regional One" Receiver. It also gives absolutely best results as a smoothing choke. **Note the high smoothing inductance of 45 henries at 50 milliamps.**

Ask your dealer for Leaflets fully describing these components, also for complete Catalogue. If any difficulty write direct, giving name of usual dealer.

Resistance D.C. 430 ohms.
Inductance 60 henries at 10 milliamperes.
Inductance 45 henries at 50 milliamperes.
Maximum D.C. 75 milliamperes.

21/-

The Mark of **RI LTD** ***Radio Efficiency***

MADRIGAL WORKS, PURLEY WAY, CROYDON

TANNOY PRODUCTS

"ALL-ELECTRIC" RADIO-GRAMS

Not massed produced, but individually built—A matched transformer coupled moving-coil speaker is incorporated in this set—slow speed induction motor, high stage gain screen grid H.F. power detector, one R.C. stage and with 10 watt power output stage — illuminated dials.

PRICES from **45 Gns.**

MAINS UNITS

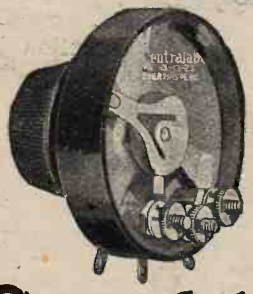
A.C. and D.C. models from stock suitable for all voltages. No hum. Everlasting—trouble free.

H.T. 120 V. at 15 m/a **£2 17 6**

H.T. and L.T. combined (with Westinghouse Rectifier) **£5 10 0**

DALTON STREET, WEST NORWOOD, S.E.27

It would be fatal to lose Control



Electricity . . . part and parcel of a city's life . . . but at the Power Station lynx-eyed men are ceaselessly watching the quivering needles of delicate instruments. When man plays with mighty forces it would be fatal to lose control.

So, too, with your radio—control is vital. It has been the privilege of CENTRALAB to furnish the volume controls of millions of radio receivers.

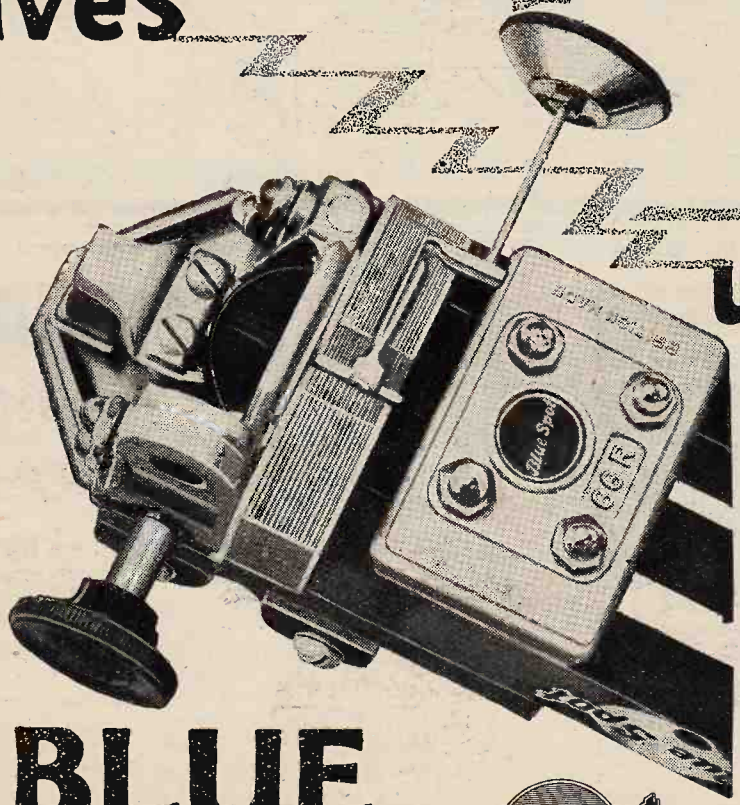
Is your radio CENTRALAB equipped?

Centralab

THE ROTHERMEL CORPORATION LTD.,
24, Maddox Street, London, W.1.
'Phone: MAYFAIR 0578/9.

Continental Sales Office: **27, QUAI DU COMMERCE, BRUSSELS, BELGIUM.**

Release that imprisoned force that lives within your set!



The loudspeaker is the final arbiter on all sounds broadcast. It is in many cases a barrier which holds back volume, coarsens reproduction through lack of sensitivity and mars the work of a first-class receiver. Not merely a good loudspeaker is good enough—only the superlative excellence of the Blue Spot can reveal with unquestionable perfection everything broadcast. Though highly sensitive Blue Spot carries heavy loads without a hint of "blare" or "boom." Hear the Blue Spot demonstrated at any radio store and realise its superiority.

Blue Spot Power Unit Type 66P - -	27/6
Blue Spot ,, ,, Type 66K - -	25/-
Blue Spot Major Chassis Type 37R - -	15/-
Blue Spot Special ,, Type 31R - -	10/6

BLUE SPOT 66R 35/-

Blue Spot TRADE MARK

THE BRITISH BLUE SPOT COMPANY LTD

BLUE SPOT HOUSE · 94/96 ROSOMAN STREET · ROSEBERY AVENUE · LONDON · E.C.1

'Phone: Clerkenwell 3570. 'Grams: "Bluospot, Smith, London."

Distributors for Northern England, Scotland and North Wales, H. C. RAWSON (Sheffield and London) LTD., 100, London Road, Sheffield; 22, St. Mary's Parsonage, Manchester; 183, George Street, Glasgow.

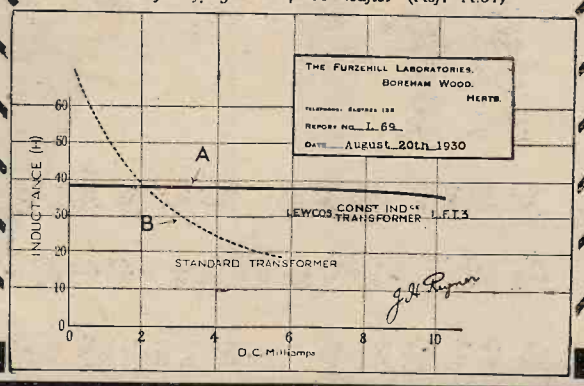
CONSTANT INDUCTANCE MEANS CONSTANT PERFORMANCE irrespective of signal strength

DISTORTION ELIMINATED WITH THE LEWCOS CONSTANT INDUCTANCE TRANSFORMER for first or second L.F. stage

CONSTANT INDUCTANCE UP TO 10 MILLIAMPERES D.C.

Price 20/- Ratio 3-1 Ref. L.F.T.3

Write for fully descriptive leaflet (Ref. R.61)



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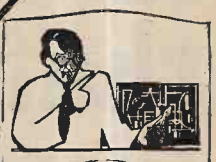

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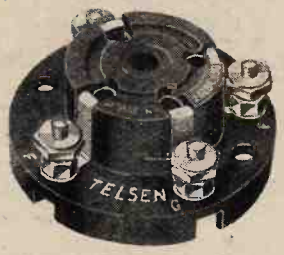

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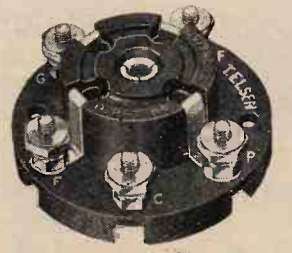

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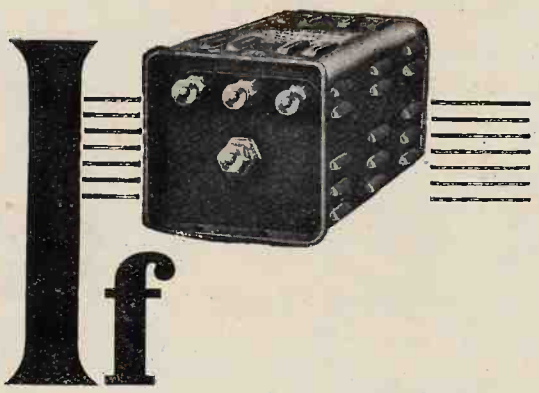

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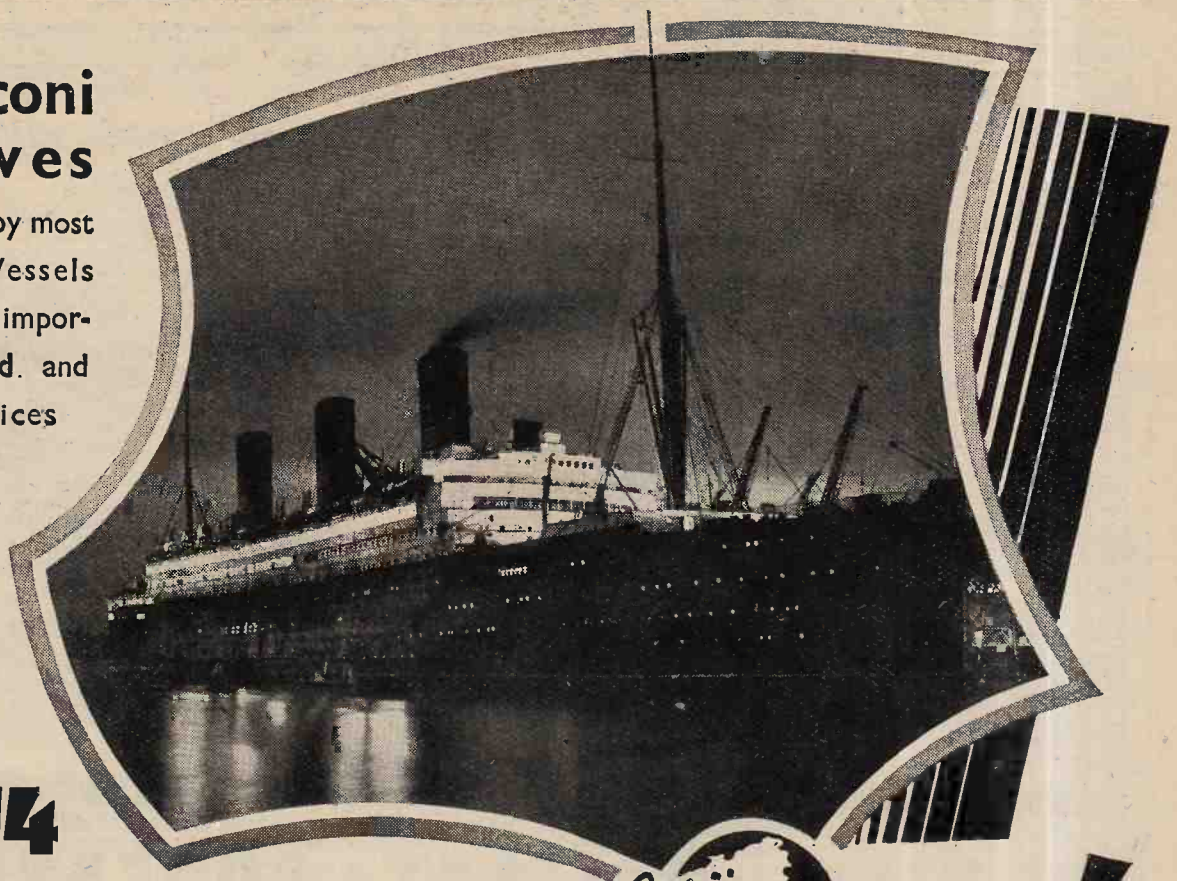

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Editorial Comment

An Alternative Long-wave Station?

WHAT progress, if any, is the B.B.C. making in the direction of obtaining facilities to establish a second long-wave transmitter in this country to provide alternative programmes? In view of the undoubted demand which exists for an alternative to Daventry 5XX, now styled the "National" transmitter, we think it is due to the public that the B.B.C. should disclose what their intentions are in regard to the future of long wavelength transmission.

We have already put forward the suggestion that the B.B.C. should take immediate steps in an endeavour to stake a claim for a second long wavelength. If anything is to be done it must be done at once, for with the increasing congestion resulting from the establishment of additional stations the chances of being able to fit in a second long-wave transmitter become more remote as time goes on. It is difficult enough as it is to see where this station could be accommodated, but at the moment it does not seem to be impossible. It is illogical that a policy of alternative programmes for this country should have been established for the shorter wavelengths and not for the long-wave band, considering that it is freely admitted that the long-wave station is the only transmitter which provides satisfactory reception over very large areas of the country.

The agreements entered into internationally at the Washington Conference have certainly restricted the chances of fitting in additional long-wave stations, but as far as Europe is concerned, the regulations have been left somewhat elastic, and it would seem that additional stations can still be included, provided they do not interfere with existing services.

It would, we believe, be worth while in this country to establish a second long-wave transmitter, even if the concession were only a temporary one, for it is admitted that the Regional station scheme to cover the whole country is going to take several years to complete, whereas one additional long-wave station could be put up quickly and would serve to give alternative programmes throughout the country during the period that the shorter wave regional transmitters are being planned and erected. If, then, it is found that the shorter wave transmitters do cover the whole country efficiently, we could part with the temporary long-wave transmitter, and perhaps with 5XX as well, without regrets.

It ought not to be necessary to plead with the B.B.C. to make a statement on the matter; on a subject of so much national interest the public is entitled to a prompt and voluntary statement from the Corporation.

Many of the difficulties in the way of pursuing the matter would be overcome, we believe, as soon as the B.B.C. showed willingness to go into the question, with the support of the Post Office.

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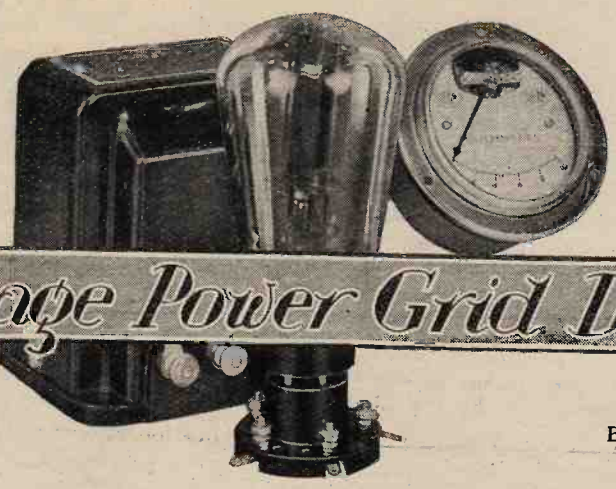

Low Voltage Power Grid Detection

By W. T. COCKING.

Modified Intervalve Couplings.

It is now well known that power grid detection offers considerable advantages over leaky-grid and anode bend rectification, both from the points of view of quality and of sensitivity. Owing to difficulties in the low-frequency intervalve coupling, however, its use has been confined to receivers in which a minimum high-tension supply of 250 volts has been available. High voltages are easily and economically obtainable when the power supply is taken from A.C. mains. Many of the modern power valves, however, are capable of giving a large undistorted output with no more than 200 volts anode potential. It therefore becomes of importance to find a method of intervalve coupling which will allow of the use of power detection with an H.T. voltage of this order.

THE parallel-feed method of intervalve coupling used after a power grid detector usually demands a high initial voltage. For this reason the power detector has been limited to receivers where voltages of the order of 300 are available. Those having only a modest H.T. voltage have hitherto been neglected in this field and will find a great deal of information in this article on types of coupling which are suitable for potentials of about 200.

The intervalve coupling difficulties are two—that of securing a good frequency characteristic, and that of obtaining freedom from feed-back troubles. Both of these difficulties are due to the same causes, which are the necessity for a high voltage on the anode of the detector and the high, steady anode current passed by the valve. In the case of an AC/HL valve, the minimum anode potential for satisfactory results is about 100 volts, at which the steady anode current is about 5 mA. The best results, however, cannot be obtained with less than 120 volts, and the anode current is then some 6.5-7 mA. It is the difficulty of obtaining chokes and transformers with a primary inductance sufficiently high when carrying this current to give full bass reproduction which has led to the adoption of the resistance-transformer-coupled circuit of Fig. 1.

Experience has shown that with a fixed H.T. voltage the best value, in all ordinary circumstances, for this coupling resistance R is 20,000 ohms, and that any other value leads to a reduced output. Now 6.5 mA. flowing through a 20,000 ohms resistance gives a voltage drop of 130, so that, if the full advantages of power detection are to be obtained, the H.T. supply cannot be much less than 250 volts. Owing to feed-back troubles, however, this circuit as it stands can only be used successfully when push-pull is adopted for the power output stage. When it is desired to use only a single output valve it becomes necessary to insert the usual decoupling resistance and condenser. This resistance will cause a further drop of at least 50 volts, and it becomes necessary to use an H.T. supply of at least 300 volts when a resistance-transformer-coupled power detector is used without a push-pull output stage.

The obvious alternative to resistance coupling is the substitution of a choke of low D.C. resistance, as in Fig. 2. This is not as simple as it appears, however, for the choke requirements are exacting. In the first place, when the intervalve coupling consists of either a choke or a transformer the inductance of the winding must not be less than about 80H. when a 10,000 ohms valve is used, if a loss of bass notes is to be avoided. When, however, a choke-fed transformer is used, the choke requirements are still more stringent, for the choke and the transformer primary are effectively in parallel, and the total inductance is less than that of either. If the transformer primary has an inductance of 200H., then the choke inductance must not be less than 133H., to give a total effective inductance of 80H.

This inductance must be maintained with a direct current of from 6 mA. to 12 mA. through the winding, and the D.C. resistance must be low, otherwise there is no point in using the choke to save the voltage drop across a coupling resistance. The self-capacity of the choke must be low, particularly if an L.F. transformer is not used, in order to avoid a high-note loss, and to allow of the use of a reasonably large capacity for the

Low Voltage Power Grid Detection.—

detector by-pass condenser; the self-capacity should not be larger than about 0.0005 mfd.

Until recently there has been no suitable choke available, but the new Varley 300H. choke has been found satisfactory. Although rated to carry 10 mA. D.C. only, it works well with 12 mA. through the winding, and with this current the inductance is about 160H., while with 6.5 mA. to 7 mA. it is about 200H. The D.C. resistance is about 3,000 ohms, while the self-capacity is sufficiently low to prevent a high-note loss.

The D.C. voltage drop with this choke, however, is by no means negligible; with 12 mA. current it is 36 volts, and with a current of only 6.5-7 mA. it is 20 volts. In practice, therefore, when an anode potential of 120 volts is required the potential at the end of the

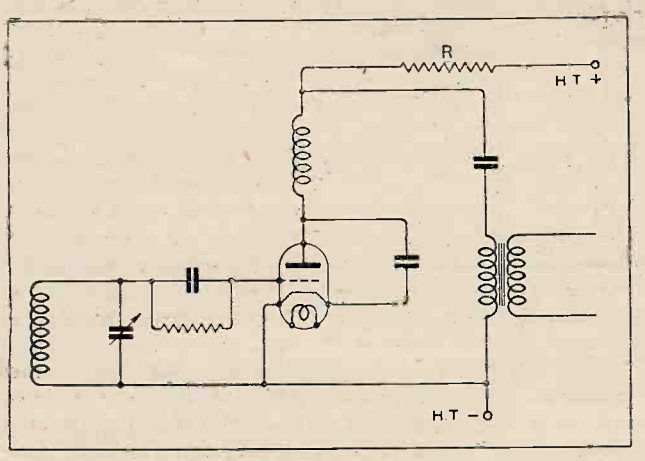

Fig. 1.—The usual resistance - transformer coupled power detector circuit. With an AC/HL valve, the best value for R is 20,000 ohms.

choke must be at least 140 volts, and on a 200 volts supply this only allows some 60 volts for the drop in the decoupling resistance. With a current of 7 mA. this resistance cannot be higher than 8,600 ohms, which necessitates a large capacity for the decoupling condenser if feed-back troubles are to be avoided.

Motorboating.

The chief trouble with power detection is undoubtedly feed-back, and is entirely due to the low value decoupling resistances which must be used to avoid an excessive D.C. voltage drop. It has been the writer's experience that the circuit shown in Fig. 2 is not entirely satisfactory. With this circuit it is essential to use the smoothing circuit shown, and, in addition, the decoupling condenser C_1 must have a capacity of at least 8 mfd. This applies to the case when the intervalve transformer has a ratio of 3.5-1 with a P.625 output valve. A transformer with a higher step-up ratio or an output valve with a higher amplification factor, such as a pentode, will increase the feed-back.

It is also very important that the choke-condenser loud speaker output circuit shown be used, and an attempt to use a transformer led to hopeless motorboating. The factor of safety against motorboating is so small that care must be taken to reduce feed-back to a minimum at every stage of the set. To this end, it is well to bear in mind the following points governing the choice of components for the output filter. The reactance of the choke L_2 (Fig. 2) at the lowest frequencies, say, 20 cycles, must be high compared with the combined impedance of the coupling condenser C_2 and the loud speaker in series. It is not sufficient that it be high compared with the speaker impedance, for the reactance of the coupling condenser may be much higher than the speaker impedance at these low frequencies. To take a practical case, suppose that the speaker has a D.C. resistance of 628 ohms; at 20 cycles its impedance will be very nearly the same; the usual 4 mfd. coupling condenser has a reactance of very nearly 2,000 ohms at this frequency, and the total impedance will be $\sqrt{(4 \times 10^6 + 3.94 \times 10^5)} = 2{,}100$ ohms. To give an effective reduction of feed-back, the choke reactance must be at least three times this figure, or 6,300 ohms; this leads to a choke inductance of $6{,}300/6.28 \times 20 = 50$H. approximately. This is a considerably higher value of inductance than is normally used for an output choke, but it is very necessary if feed-back troubles are to be reduced to any extent.

It is interesting to see what the values of components would have been if selected in the usual way, by making the choke reactance three times, and the coupling condenser reactance one-third, of the speaker impedance. A short calculation shows that a 15H. choke will suffice, but to obtain freedom from feed-back the coupling condenser must have a capacity of not less than 38 mfd.! The high inductance choke is obviously the more economical, but, nevertheless, a choke which has an inductance of 50 H. when carrying 25 mA. to 50 mA. D.C.,

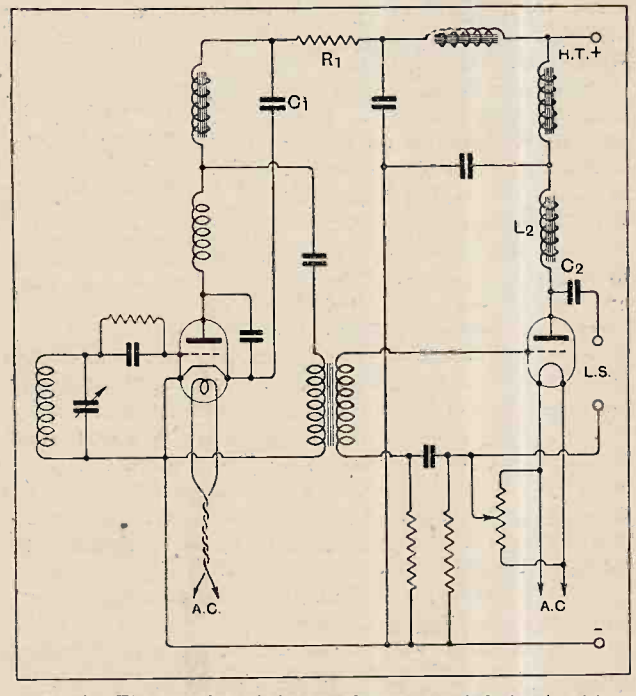

Fig. 2.—The complete choke transformer coupled circuit with a single output valve. As explained in the text, this circuit is not entirely satisfactory. With a 200 volts H.T. supply, R_1 must be 8,600 ohms. and C_1 about 8 mfd., while the choke L_2 must have an inductance of 50 henrys when C_2 is 4 mfd.

Low Voltage Power Grid Detection.—

according to the output stage used, is by no means inexpensive. The use of such an output filter, however, is essential in order to make the circuit of Fig. 2 workable.

Now it is characteristic of the push-pull method of connecting the output valves that feed-back from this stage is almost completely eliminated. It would appear, then, that the use of push-pull would give freedom from motorboating and allow more latitude in designing the receiver. This is found to be the case in practice, and with the circuit of Fig. 3 no trouble at all has been experienced, using a 3.5-1 ratio transformer and a pair of P.625 output valves. It will be noticed that the decoupling circuit has been omitted, and it only becomes necessary when the output of the smoothing circuit is greater than 150 volts. Even in this case the use of a resistance in series with the smoothing choke L will give the desired voltage drop in the most economical manner.

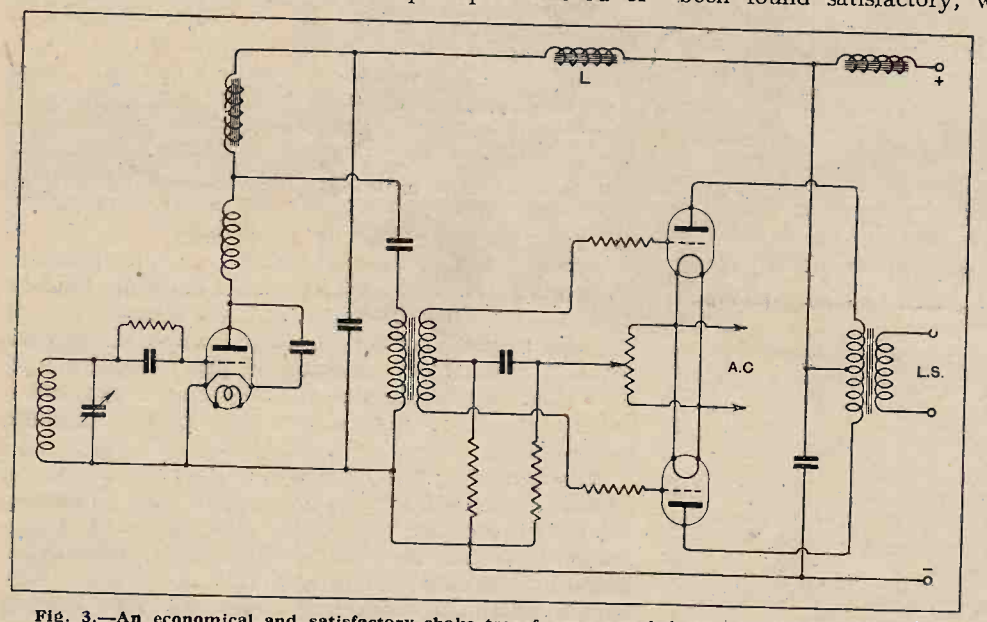

Fig. 3.—An economical and satisfactory choke-transformer coupled circuit. The H.T. supply needs no decoupling, and a proportional smoothing circuit can be used.

Where a fairly high degree of low-frequency amplification is desired, the use of a push-pull output stage will prove more satisfactory and actually cheaper than the conventional single output valve with elaborate decoupling and choke-condenser output circuits. By its use not only are decoupling circuits and special feed-back precautions eliminated, but the amount of smoothing required is reduced, and a more economical circuit becomes possible. At the same time, the advantages of push-pull of reduced second harmonic distortion and increased power output are retained.

In some cases, however, it may not be considered desirable to employ push-pull, and if a single valve will give a sufficient output the circuit of Fig. 4 will be found to be the most satisfactory. By omitting the L.F. transformer the amplification is reduced, and also the effects of feed-back; as a result the circuit will prove satisfactory without unreasonable values for the decoupling components. With a decoupling resistance R_1 of 8,600 ohms the condenser C_1 should have a capacity of 4 mfd., although 2 mfd. is often sufficient. The output filter need have no different values from the usual, and a 15H. choke with a 2 mfd. condenser has been found satisfactory, while the set is quite stable even with an output transformer. The output of the AC/HL power grid detector with this coupling is ample fully to load any ordinary power output valve worked with 200 volts H.T., and an AC/HL detector with a P.X.4 output valve makes an excellent combination.

Adjustment of Tone.

Wherever a sufficiently high H.T. voltage is available the resistance-coupled circuits will be found the most satisfactory, due to the improvement in transformer characteristics which results when the primary winding is shunted by a resistance. The improvement is not obtained with the usual choke coupling, and, as a result, both the very low and the very high notes are not reproduced to quite the same extent. Nevertheless, the choke-coupled circuit is capable of extremely good results. Most good L.F.

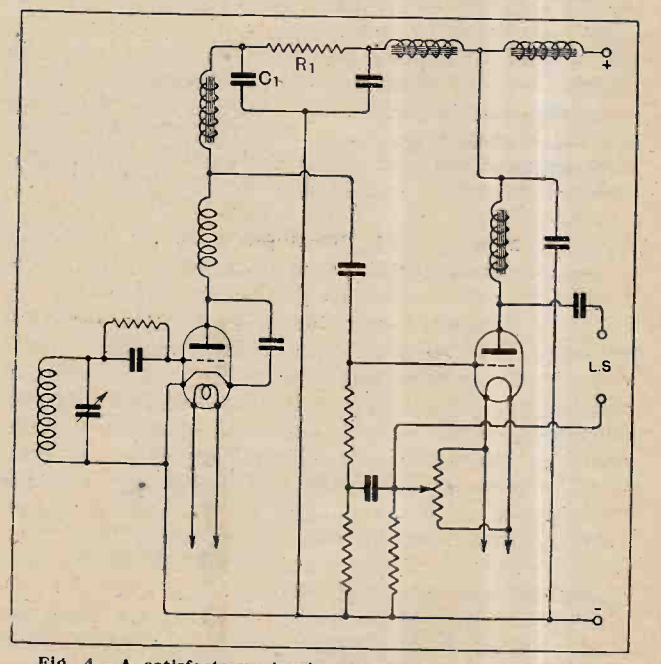

Fig. 4.—A satisfactory circuit with a single output valve; owing to the low amplification, feed-back effects are very small. The resistance R_1 should have a value of 8,600 ohms, with a 200 volts H.T. supply, and the condenser C_1 a capacity of from 2 mfd. to 4 mfd.

Low Voltage Power Grid Detection.—
transformers have a characteristic rising at the higher frequencies, and this effect is accentuated by the presence of a resistance across the primary winding. In many cases this effect is of great use in providing a certain amount of compensation for a high-note loss in other parts of the receiver, but when a choke-coupled transformer is used this rising characteristic is to a large extent lost. It may be retained, however, by shunting the primary winding by a resistance of the correct value to give the desired characteristic, In other words, if the circuit of Fig. 1 will give the desired frequency characteristic, but fails, owing to the low voltage available, the detector output can be increased without an appreciable alteration to the high-note amplification merely by connecting a choke in parallel with the coupling resistance. The D.C. passes through the choke, which is of low resistance, and the high anode voltage will then allow of a large output being obtained. The amplification at the very low frequencies will be slightly less than that with the pure resistance-transformer circuit, but at all other frequencies will be practically unchanged.

When the H.T. supply is limited to 200 volts the best results will be obtained with the choke-transformer-coupled push-pull circuit of Fig. 3, while if only a single output valve be desired the plain choke-coupled circuit of Fig. 4 can be relied upon. The choke-transformer circuit with a single output valve (Fig. 2) cannot be generally recommended with H.T. voltages lower than 300 owing to the difficulty of decoupling.

Operating Notes.

The action of the power grid detector with choke coupling is in no way different from that of the usual resistance-coupled circuit, but several practical differences may make themselves evident. The actual rectification efficiency is unaltered, but the amplification efficiency of the valve is increased. It was pointed out in the original article on this method of rectification[1] that a grid detector can be considered as a diode rectifier followed by a low-frequency amplifier. The rectification efficiency is not affected by the method of intervalve coupling adopted, but the amplification efficiency depends upon the ratio of external to internal anode impedance, just as in an ordinary amplifier. The AC/HL with a 20,000 ohms coupling resistance gives an L.F. amplification of about 21 times, but with choke coupling this becomes about 35 times, an increase of 66 per cent. For a given H.F. input voltage, therefore, the choke-coupled detector will give a considerably greater L.F. output voltage than the resistance coupled.

The second point of difference between the two methods of coupling lies in the fact that there is no simple relation between the change of anode current recorded by a milliammeter when a signal is applied to the grid of the valve and the output voltage developed across the choke. With resistance coupling it is merely necessary to multiply the change of anode current in amperes by the value of the coupling resistance in ohms to obtain an approximate figure for the peak L.F. voltage across the resistance for 100 per cent. modulation. The change of anode current with choke coupling, however, is determined by the resistance in circuit, but the L.F. voltage is determined by the choke reactance, and there is consequently no simple relation between them.

Just as in the case of resistance coupling, the milliammeter will show up distortion occurring in the amplifying portion of the detector. A flicker of the needle in an upward direction denotes that second harmonic distortion is present, due to working on the curved portion of the grid volts—anode current curve—and the remedy is either to reduce the H.F. input voltage or to increase the H.T. voltage until the needle ceases to "kick upwards." A flickering of the needle in a downward direction does not necessarily indicate distortion, for it is a necessary result of rectification. No difficulty should be experienced in preventing the needle from flickering upwards, for the use of choke coupling allows a fairly high H.T. voltage readily to be applied to the anode of the valve, and a large undistorted output to be obtained.

With a steady anode current of 12 mA. the current change due to the H.F. input can be as high as 3 mA. without distortion, and a very large L.F. output is then obtainable. With steady currents of about 7 mA. it is unwise to work with a greater change of current than about 1.5 mA. No exact figures can be given, for, as just pointed out, the change of anode current obtained with a given H.F. input depends upon the circuit resistances, including the valve internal resistance, the choke resistance, the resistance of the decoupling circuit (if any), the resistance of the smoothing chokes, and even the H.T. rectifying valve and mains transformer. These will obviously be different in every case, and so the change of anode current will also be different in every case. To a certain extent this is also true of resistance coupling, but the coupling resistance then forms a large proportion of the total resistance, and most of the external resistance can be neglected.

[1] Power Grid Detection, *The Wireless World*, May 7th, 1930.

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FRENCH SHORT-WAVE TESTS.

The 80th series of short-wave tests will be carried out by the French Meteorological Office on December 13th, with preliminary tests on December 6th. The series will follow much the same lines as in the 79th test, of which particulars were given on page 216 of our issue of September 3rd.

Transmissions will begin on December 13th at 09.30 G.M.T. from Lyons FYR on 38 metres, followed at five-minute intervals by Lyons FYS (26.15 metres), Lyons FYQ (16.35 metres), Trappes FOW (26.15 metres), Lyons FYS (60 metres), Paris FLE (36.70 metres), Lyons FYR (25.75 metres), and Trappes FOW (60 metres).

The series will be repeated at 11.30, 13.30, 15.30, 18.00, 20.00 and 22.30 G.M.T., but in the last three tests Paris FLE will be replaced by FLJ on 32.50 metres.

The preliminary tests on December 6th begin at 13.30 and 20.00 respectively, FLE taking part in the first and FLJ in the second. Each transmission will last for ten minutes, and consist of a series of É's in Morse (· · — · ·), interspersed with test groups of five figures; the second half of each transmission will, therefore, overlap the first half of the next.

Reception report forms are issued by the Office National Meteorologique, 176, rue de l'Université, Paris.

On the occasion of the previous series, last September, Mr. J Hunter, 63, Hervey Road, Blackheath, S.E.3, very kindly offered to forward to the French Meteorological Office reports from listeners who had not been able to secure the necessary forms, and we understand his offer holds good for the coming series.

LOCAL AMPLIFICATION OF FIELD STRENGTH

Helping the Town-dweller to Receive Distant Stations.

By ERICH SCHWANDT (Berlin).

AT a recent meeting of the Heinrich Hertz Society in Berlin details were published by Manfred von Ardenne of a method of improving distant reception for the dwellers in large towns—a method which it is suggested may bring about a remarkable change in urban reception. The experiments already carried out are said to be very promising.

The scheme of amplification of field-strength starts from the assumption that in urban districts the field-strength of the distant transmitter may be reduced by as much as 90 per cent., by absorption due to buildings and masses of metal, so that no more than 10 per cent. of the original field is left, while in the country this weakening does not take place. It is further assumed that in a town the amount of interference may be as much as 50 to 100 micro-volts per metre, while in the country it is not likely to exceed 1 to 2 micro-volts per metre—about one-fiftieth of the urban interference level. Von Ardenne proposes to take the intense, disturbance-free field which is available in the country, convey it in a suitable manner into the town, and there radiate it out afresh. In conjunction with Dr. S. Loewe he has been working on this proposal for more than a year and a half, and claims to have succeeded in solving the theoretical and practical problems that it presents. With his experimental apparatus he has succeeded in conveying signals from distant stations to a factory where they could not normally be heard, on account of interference from electric motors, with even the most sensitive receivers, in such a way that these stations were received at good strength and free from interference with an ordinary local-station receiver. Signals were picked up at his laboratory, a mile and a quarter away, and retransmitted from there to the factory.

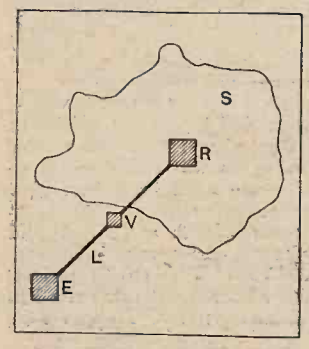


Fig. 1.—Schematic diagram of a field-strength amplifying equipment with land-line connection. S=Urban area; E=Central receiving station; L=Line connection; R=Relay transmitter; V=Intermediate high-frequency amplifier (Aperiodic).

Reference to Fig. 1 will explain the technical details of the process. Outside the borders of the town, at a point where reception is good and interference small, the central receiving station E is set up. This station is equipped with highly sensitive receivers, with band-pass filters, compensating devices to check fading, and all modern improvements, to pick up the field of the distant transmitters. If the so-called "selective method" is adopted there must be one receiver for every station to be retransmitted in the town. In the central receiving station very considerable amplification of the received signals is carried out at high frequency; detection does *not* take place, for the received field is to be conveyed to the town in its original high-frequency form, and not relayed as a detected low-frequency signal in the manner hitherto adopted. For this, high-frequency power amplifiers are required, in which the last stages are equipped with valves of similar power to those used as output valves in large low-frequency power amplifiers.

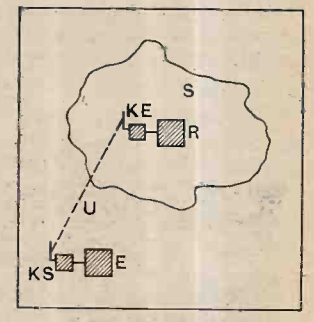


Fig. 2.—Schematic diagram of a field-strength amplifying equipment using ultra-short waves as a link. S=Urban area; E=Central receiving station; R=Relay transmitter; U=Ultra-short waves; KS=Ultra-short-wave transmitter; KE=Ultra-short-wave receiver

For conveying the power it is possible either to use as in Fig. 1 a so-called "power lead," of the kind used to connect a short-wave transmitter with a beam aerial at some distance from it, or, as suggested in Fig. 2, the amplified high-frequencies may be used to modulate an ultra-short wave, which is radiated into the centre of the town. To avoid interference, very precise directional transmission, and in addition the use of polarised waves, is desirable. The amplified high-frequency field is reradiated by a relay station R.

Amplification of all Transmissions.

For satisfactory operation it is required that the field-strength of this transmitter be so chosen that the amplified field is considerably weaker at the central receiving station than the original field from the distant station. The relay station will normally have about 10 to 20 per cent. of the power of the local station; in this way freedom from interference with the local station is assured, while the usual two-valve and three-valve local-station receivers using reaction will suffice

Local Amplification of Field-Strength.—

to provide programmes as loud and as uninterrupted as those from the local station.

In addition to the "selective method" described, there is also the possibility of using an "aperiodic method," which would not be limited to a few individual stations, but would involve the even amplification and retransmission of the whole wave-range from 200 to 600 metres. For this both the amplifier and the relay station would naturally have to be completely aperiodic; to achieve, in spite of this handicap, the same results that can be had with the selective method, more stages of amplification and a higher-power relay transmitter would have to be used. This method, too, has been fully worked out both theoretically and practically, so that its introduction is now practically possible. The general scheme is shown in Fig. 3, while Figs. 4 and 5 show views of the apparatus used in the experiments.

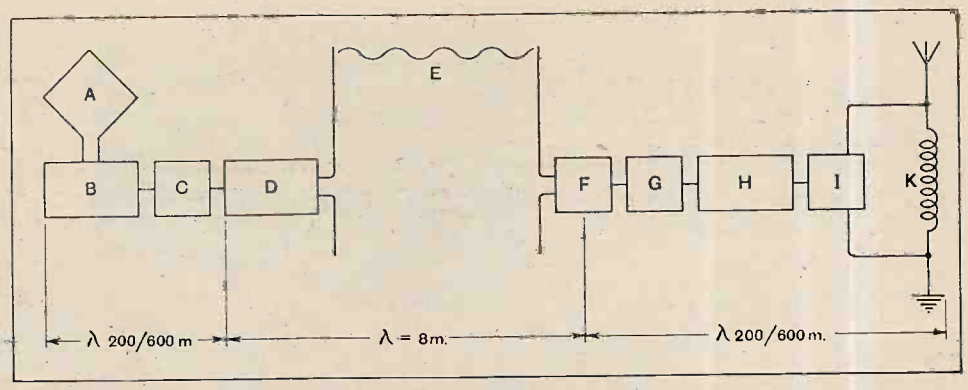


Fig. 3.—Schematic diagram of an aperiodic field-strength amplifying equipment. A=Aperiodic receiver; B=Band-filter; C=Aperiodic high-frequency amplifier; D=Ultra-short-wave transmitter; E=Ultra-short waves; F=Ultra-short-wave receiver; G=Preliminary amplifier; H=High-frequency power amplifier; I=Band-filter; K=Aerial circuit of relay transmitter.

The great importance of von Ardenne's scheme lies in its ability to make clear and uninterrupted reception of distant stations possible to the town-dweller, without making it necessary for him to use anything more elaborate than the simple receiver he already possesses. He would have at his disposal the same choice of programmes that is available to the listener living in the country or in a small town, and who receives there with a multi-valve set. The whole equipment has the same effect as if the town possessed a common central high-frequency amplifier, which brought all the distant stations to the listener's doorstep.

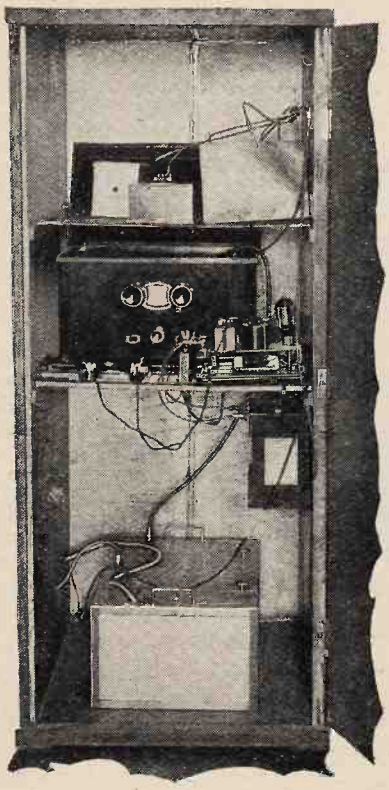


Fig. 4.—Arrangement of the central receiving station (experimental model). In the screened cupboard; short-wave band filter, broadcast receiver, and (below) high-frequency power amplifier.

The German Commissioner for Broadcasting, Dr. Bredow, is stated to be very interested in the new project, and has advised the trade to erect an experimental installation on a big scale. The expense of such an installation would certainly not be greater than that of an ordinary broadcasting station, and would probably be speedily repaid by the increase in the number of licence-holders. In every town in every country there are many who only remain aloof from wireless because they would be tied down to a single station, and would resent this monopoly. Give such possible listeners the opportunity of receiving on a simple and inexpensive set all the most representative stations of Europe, and they would become the most enthusiastic of listeners.

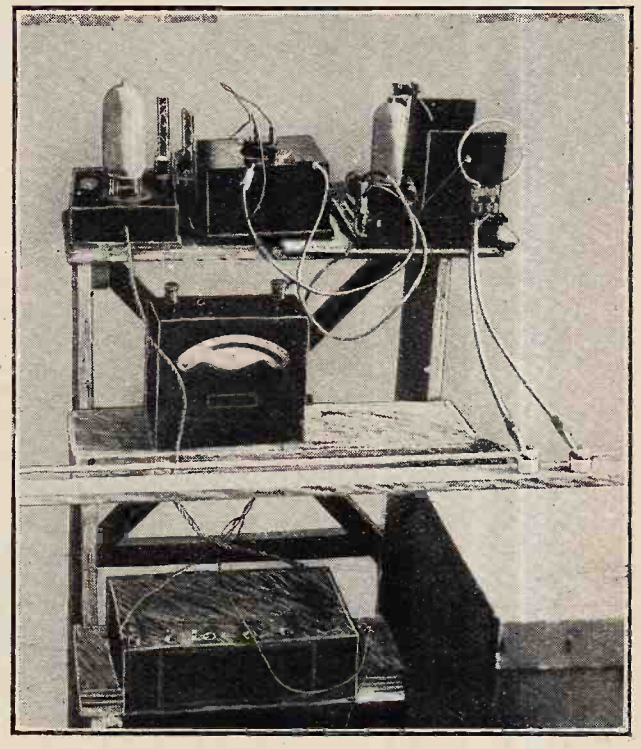
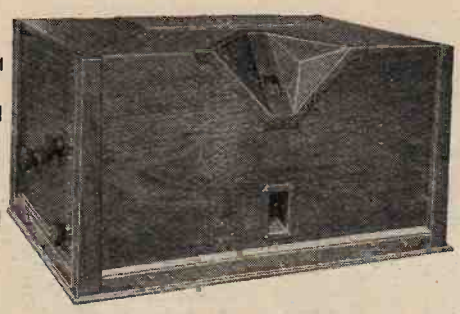


Fig. 5.—Experimental apparatus for investigating questions of modulation in connection with ultra-short waves.

GECOPHONE FOUR-VALVE ALL-ELECTRIC A.C. RECEIVER



Test Report with Constructional and Circuit Details.

IN the period between the Exhibitions of 1929 and 1930 radio manufacturers were faced with an entirely new problem. The time when a receiver might consist of a baseboard assembly and vertical panel had definitely drawn to a close, and everyone realised that a radio receiver could no longer resemble an experimental outfit. The new specification to which sets had to be built involved such radical changes as single-dial control, coils in screening compartments, ganged wave-change switching, all-mains operation, and chassis construction. All these features are present in the Four-valve Screen Grid Receiver of the General Electric Co., Ltd. As an example of modern production this receiver is remarkable and reveals the superiority of the manufacturing facilities possessed by a firm whose activities include the making of all classes of electrical gear. Nothing has been spared in the provision of tools for the stamping and shaping of hundreds of metal parts. Every single piece is the product of repetition machinery which, while involving enormous initial outlay, leads, as far as the purchaser is concerned, to reliability and good value for money.

Dealing with the mechanical details, it is to be noted that the components are carried on a substantial iron frame giving support to the coils, ganged tuning condensers and mains equipment on the top side, and the valve compartments and L.F. equipment underneath. Components are so arranged that the entire space within the overall rectangular dimensions is entirely filled, a feature usually difficult to carry out where H.F. amplification is involved, and giving the great advantage of compactness. Complete screening is provided for the H.F. valves, and the various by-pass condensers are included within the valve screens. The coil compartments are immediately over the valves, to which they form the tuned input. Rectangular containers with rounded corners screen the coils. Long- and short-wave coils stand vertically side by side, and they are screened from each other by a barrier within the container. Double contact switches short-circuit the long-wave coils when tuning to the broadcast band.

SPECIFICATION.

All-electric Four-valve Screen-grid Receiver. Type B.C.3140.

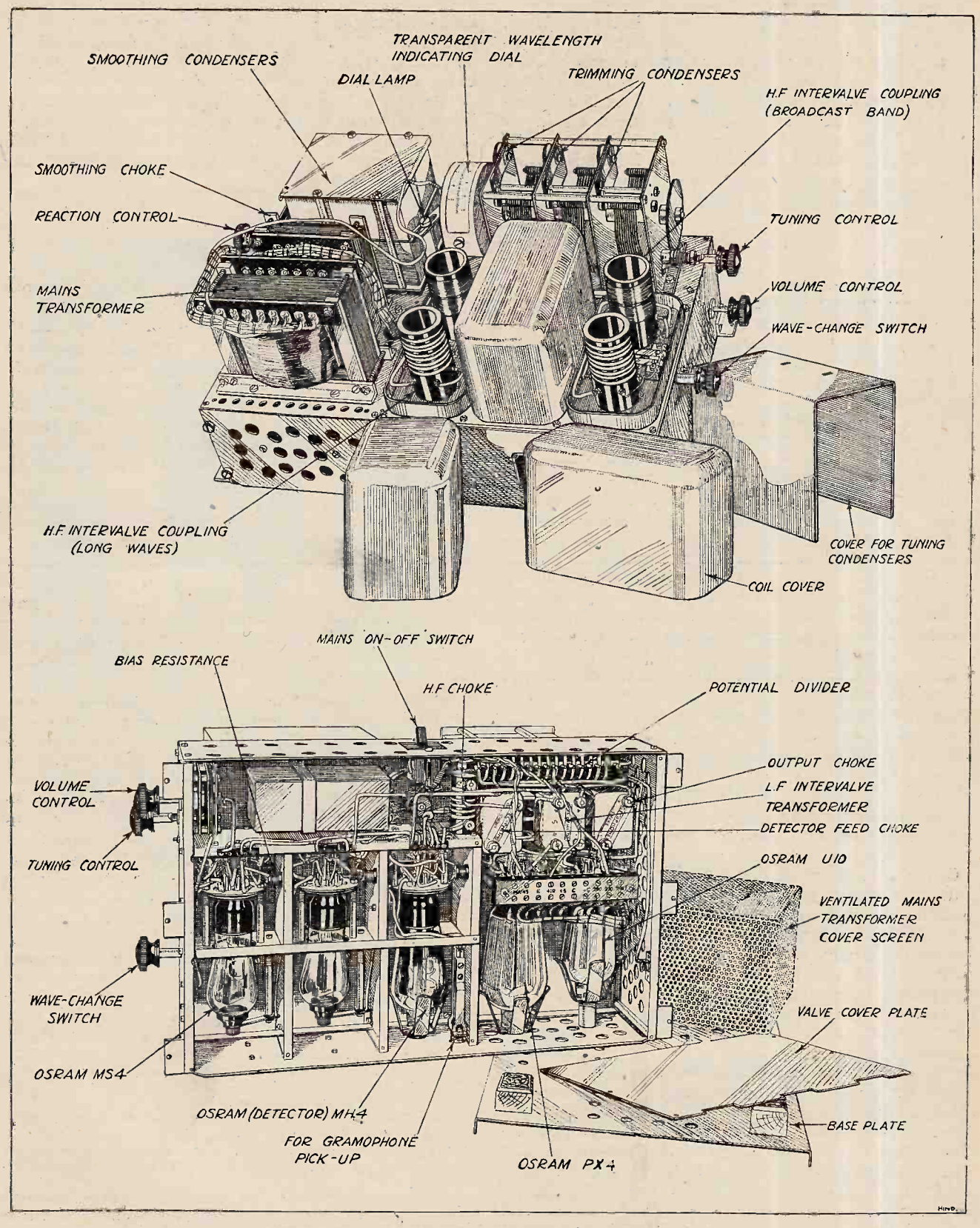
Two H.F. stages (Osram M.S.4). Power grid detection (Osram M.H.4). Power triode output (Osram P.X.4). Transformer coupled H.F. stages. Ganged wave-change switching. Single dial tuning control by ganged condensers. Volume control by series aerial condenser. Choke filter-fed output. Reaction control applied to detector. Valve rectification (Osram U.10). Operating controls on ends of cabinet. Illuminated wavelength calibrated tuning scale. Tuning coils in screening compartments. Totally screened H.F. valves. Provision for use of gramophone pick-up. Chassis built on an all-metal frame. Walnut cabinet measuring 18ins. × 10ins. × 12½ins. deep. Price, complete, £30.

A three-gang condenser stands alongside the coils. Total screening is provided between the individual sections and overall, while trimmers are provided for matching up the stray capacities. The condenser is end-driven through a heavily spring-loaded reduction gear entirely devoid of backlash or slip. A drum dial on the centre of the shaft calibrated in the two-wave ranges and illuminated from behind appears in the centre of the set, while the tuning control knob is on the end giving the ideal operating position as contrasted with the difficulty of turning small knobs on the front.

The clear layout and direct wiring readily reveal all essential features of the circuit. It will be seen from the accompanying circuit diagram that the four valves are arranged as two transformer-coupled H.F. stages, detector valve and power triode output. H.F. and detector valves are indirectly heated, being of the Osram M.S.4 and Osram M.H.4 types. The output is a generous power valve, the P.X.4, working with a modest output voltage. Rectification is by valve, the Osram U.10 type.

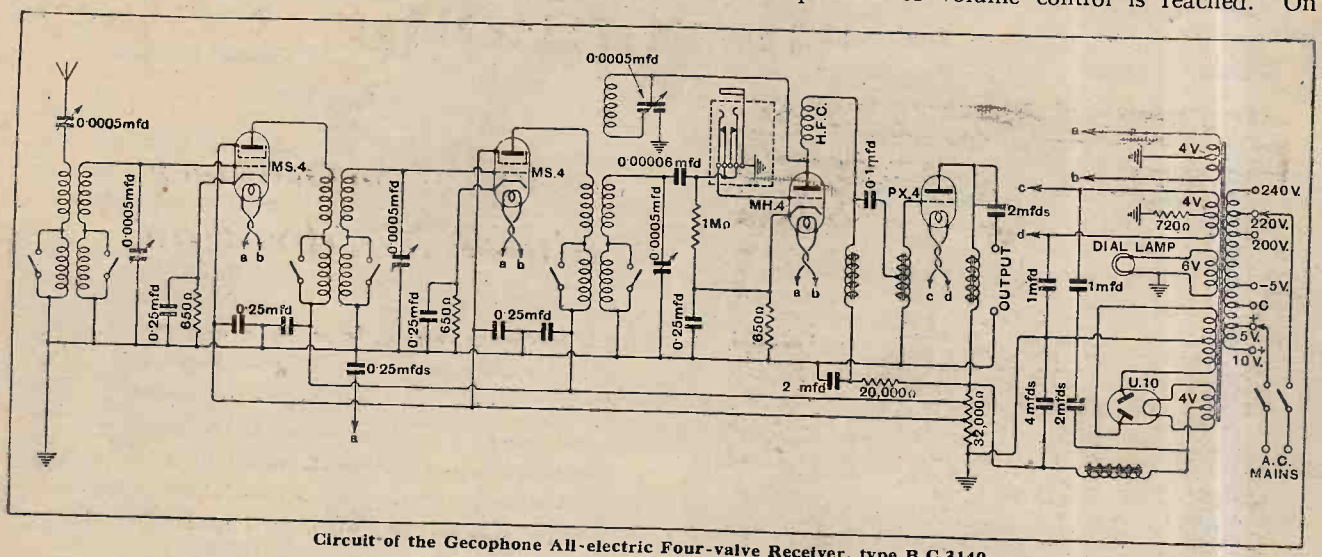
The set designer is faced with the problem of compromise between selectivity and maximum amplification in the H.F. stages. We find, therefore, that in the use of H.F. intervalve transformers the manufacturers having decided to err on the side of selectivity and stability as against the highest possible stage gain. This is good practice in the absence of the inclusion of apparatus to give a pre-H.F. control of selectivity, while subsequent test revealed good distant station-getting properties with apparent uniform sensitivity over the tuning scale.

Detection is by power grid. It is interesting to note that behind the H.F. choke in the anode circuit of the detector an L.F. choke is inserted to provide a filter feed to the L.F. intervalve transformer, though the dimensions of this choke suggest that the detector valve is working with a normal anode current. A minor but interesting detail is the production of a grid leak resistance by covering a small rod with high-resistance material and running round it a spiral cut, thus increasing the length and decreasing



Chassis details of the Gecophone All-electric Four-valve Receiver.

Gecophone All-electric Four-valve A.C. Receiver.—the cross section of the coating of resistance material. Reaction is provided in the anode circuit of the detector which tends to compensate for the loss of inherent valve reaction in the H.F. stages arising from the use of the selective intervalve couplings. Grid bias is provided for the H.F. valves by small resistances in the cathode leads, while the output valve, which is directly A.C. heated, likewise picks up its bias from a resistance in its filament-heating circuit. Pre-H.F. volume control is provided by a series aerial condenser which serves also as a control of selectivity. In preparing the set for test one finds that the transformer is not only tapped to suit 200-, 220- and 240-volt supplies, but, in addition, there are three more terminals marked 10, 5 and −5 volts. By this means all mains potentials from 195 to 250 can be accommodated to the nearest 5 volts.



Circuit of the Gecophone All-electric Four-valve Receiver, type B.C.3140.

Notes on Operation.

An entirely silent background is first noted on bringing the receiver into operation, and whereas 20 milliwatts of hum at the output may pass unobserved, the reading in respect of this receiver was considerably lower. Tested at 9 o'clock in the evening, when most European stations are operating, and steadily advancing the dial from minimum to maximum over both wave ranges, eighteen stations were counted. These stations were received free of interference, and the count did not include heterodyned transmissions and heterodyning relays. The test, however, was a severe one in that it was carried out at a distance of six miles from the London Regional station.

At so short a distance there was an interval of only a few divisions silence between the two transmissions. Turning the volume control towards minimum greatly improved the selectivity, however, but rendered the set less sensitive to distant stations. A combination of a reduction on the volume control and the application of reaction brought in several stations between the London transmissions. Attention might be drawn to the fact that the reaction and volume controls which are situated at opposite ends of the cabinet are turned in opposite directions to produce an increase of signal which is, perhaps, a little inconvenient. An excellent feature is that the reaction control is not only particularly smooth but is uniform on both wave ranges.

The control of volume, although effective, is not linear as judged by the ear. Very little change occurs in the strength of the signal from a local station until the zero position of volume control is reached. On the other hand, the transmission of a distant station disappears with but a small rotation of the control. Quality of reception is all that can be desired, and a measurement of the output between 0.1 and 1 watt delivered into a 4,000 ohm load with signals from a modulated oscillator showed the frequency range covered to be from 40 to 2,500 cycles.

Evidence of production in a well-equipped factory so marked from an examination of the chassis is likewise revealed in the cabinet work. The smooth, dull-finished walnut gives a good appearance, while the top is quartered and relieved by a bevelled panel.

oooo

Perfectavox.

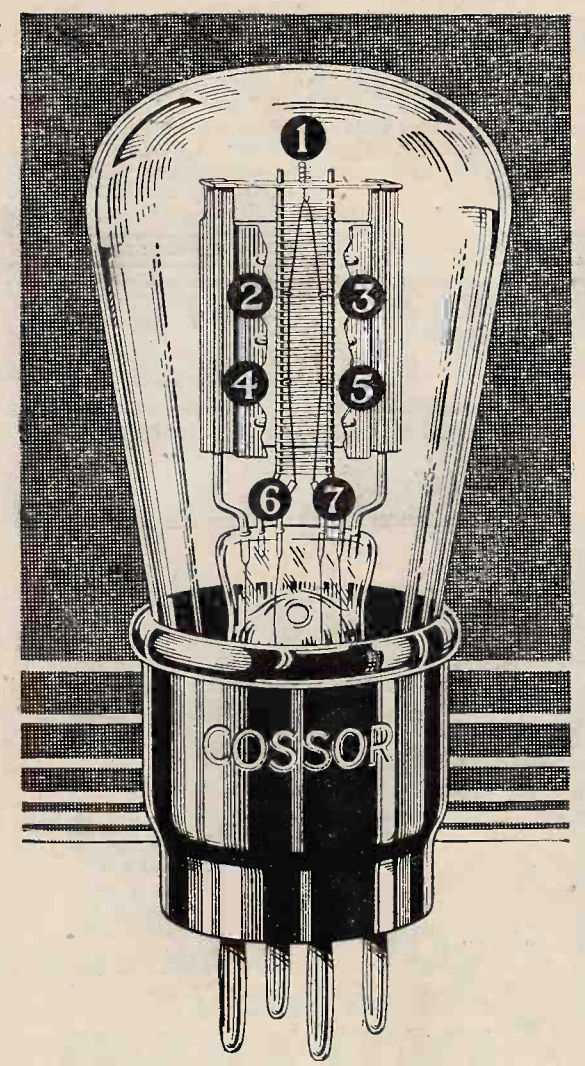
On page 581 of the Buyers' Guide issue (November 19th) particulars were given of only one of the range of radio gramophones made by Perfectavox, Ltd., Alexandra Works, High Street, Yeadon, near Leeds. The instruments which were inadvertently omitted are the "Screened Grid Minor" and "Junior Screened Grid Lion." The former incorporates a three-valve circuit with an AC/SG high-frequency valve, transformer coupled to an anode bend detector which is in turn transformer coupled to an AC/PEN output valve. Transformer coupling is provided to the moving-coil loud speaker.

The "Junior Screened Grid Lion" has an additional L.F. stage with resistance-capacity coupling, and the output consists of two P.650 valves in push-pull with transformer coupling to a moving-coil loud speaker.

Both models are fitted with B.T.H. induction motors, post detector volume controls and tone filters, and valve H.T. rectifiers.

The price of the "Screen Grid Minor" is 47 guineas, and the "Junior Screened Grid Lion" 65 guineas in oak. Walnut and mahogany cabinets are also available.

Seven point suspension *definitely prevents* microphonic noises



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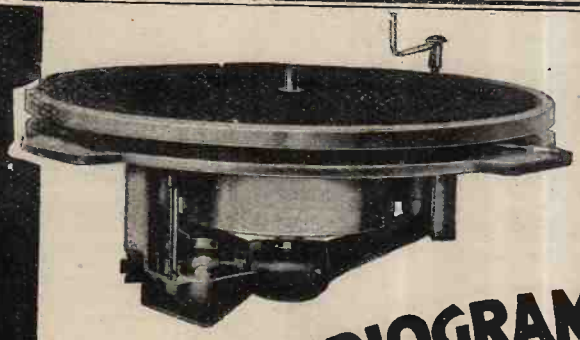

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LOUD SPEAKER IMPEDANCE

Using a Chart to Simplify Calculations.

By W. A. BARCLAY, M.A.

THERE was a time, not so very long ago, when the only link between set and loud speaker which most wireless users recognised was the obvious one of the connecting flex. Nowadays the position has completely changed. It is common knowledge that the loud speaker must be carefully chosen to work in conjunction with the output valve of the set, and that appropriate "matching" of the properties of both is essential if distortion and loss of efficiency are to be avoided.

The impedance of a loud speaker is not always a correct substitute for the D.C. resistance when it is required to estimate the A.C. power supplied. An ingenious chart is given by the author from which numerical values of resistance, inductance, impedance and frequency can be read.

ALTHOUGH the general principle of matching valve and loud speaker is recognised in a broad way, it must be confessed that its practical application in the individual case is apt to prove exceedingly difficult. Of all the component parts of a receiving set, the loud speaker is by far the most inefficient, as well as the most erratic in its performance over different frequency ranges. As is well known, the electro-acoustic efficiency of the average loud speaker is poor in the extreme; indeed, it is safe to say that of the input energy fed to the instrument, less than 2 per cent. is available for conversion into actual sound waves in the air. In addition to this, what efficiency there is is by no means uniform over the frequency spectrum. The phenomenon of resonance often appears at certain frequencies, and is due in many cases to the mechanical system of moving parts necessary to convert the electrical impulses into sound waves in the atmosphere. Moreover, the performances of different types of loud speaker differ markedly, while even instruments of similar type may behave in different ways according to circumstances.

Loud Speaker Impedance.

The D.C. resistances quoted by the makers are, of course, of no use whatever in any attempt to classify the performance of loud speakers. This has often been pointed out in *The Wireless World*, and as a first attempt at a constructive policy in the provision of loud speaker characteristics, this journal recently gave experimental values for the impedance of several different types at various frequencies.[1] The impedances in question were found in every case to differ markedly from the D.C. resistance value, being in some cases ten or even more times as large.

It will be useful to examine in slightly greater detail this concept of loud speaker impedance in order that a clear understanding may be obtained of the part which it plays in sound reproduction. The writer has noticed that there is now a tendency to treat the impedance of a loud speaker as in all cases the correct substitute for the D.C. resistance. Though for some purposes the impedance figures are a sufficiently reliable index of performance, a little reflection will show that when used to estimate the A.C. power supplied to the instrument by the output valve they lead to entirely erroneous results.

To see how this comes about, let us consider the actual composition of the speaker impedance. It will be recalled that the impedance figures supplied by *The Wireless World* were obtained "by reading the volts developed across the windings with a valve voltmeter simultaneously with the current as indicated by a thermo-junction in series with the windings." The quotient obtained by dividing the former by the latter is obviously the impedance of the windings at the frequency concerned. But it must be remembered that this impedance has both a reactive and a resistive component. If for the moment we assume the element of capacity absent from the windings, the latter may be assumed to be represented *at the particular frequency* by an inductance L and resistance R (Fig. 1). If the frequency be f cycles per second, we may then write for the impedance,

$$z=\sqrt{\omega^2L^2+R^2} \quad .. \quad .. \quad (1)$$

where ω as usual denotes $2\pi f$. It is to be carefully observed that it is only at this particular frequency f that these particular values of L and R can be used to represent the coil windings of the speaker. The unfortunate complication in the business is that, at any other frequency, these values L and R will cease to apply; in other words *they are not constants of the loud speaker but depend partly upon the working frequency.*

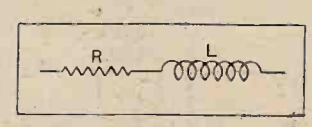

Fig. 1. — Neglecting self-capacity, a loud speaker may be assumed to act at any frequency as an inductance in series with a resistance. L and R depend on the frequency.

Effective Resistance.

It will be realised, of course, that R above represents the *effective resistance* offered by the coils at that frequency, and is quite distinct from the D.C.

[1] "Tests on Cone Units."—*The Wireless World*, 5th and 12th February, 1930.

Loud Speaker Impedance.—

resistance of the windings The effective resistance may be taken to comprise the sum of all the resistances upon which the energising current does work. It will therefore include the pure ohmic resistance of the windings (the D.C. resistance), the resistance losses in the iron, and the useful resistance which is called into being by the motion of the diaphragm system.

If, now, we consider the passage of an alternating current of speech frequency f and peak amplitude I through the coil represented in Fig. 1, we know from theory that the useful work performed will be proportional to I^2R and not to I^2z. The determination of the values of effective resistance is thus seen to be essential for the correct estimation of the A.C. watts supplied by the power valve to the loud speaker. It is also clear that, as this resistance at any frequency may differ considerably from the value of impedance obtained at the same frequency, our object must be to find some means of deriving corresponding values of R for the values of z which have been experimentally determined over the frequency range.

If the effective resistance R were approximately constant, as in the case of an ordinary coil with air core, the problem of ascertaining its amount would be relatively simple. In the present case, however, since not merely z but R and L themselves vary with the frequency, the problem of determining R and L for each different frequency for which the value of z has been supplied by *The Wireless World* is one of very real difficulty. It is, indeed, not too much to say that it would be practically insuperable, even with tedious mathematics, were it not for a very simple and easy procedure which has been devised by the writer for the solution of this and similar problems. The method, which makes use of a specially constructed Alignment Chart, is now published for the first time through the medium of *The Wireless World*.

Method of Alignment.

The advantages of the alignment chart in relating the magnitudes of different variables are by now well known to readers of this journal. The charts which have so far appeared in its pages have, however, been of the simplest type, namely, that in which each application of the index line relates the values of three such variables. In some of the "Useful Data Charts" published some time ago, it was possible by means of a second application of the index to correlate a fourth variable, but this second alignment is merely another case of the "three-variable" relation, and represents in itself no extension of that method. The Alignment principle may, however, be extended to correlate four and even more variables by a *single* application of the index line. Consider, for instance, the diagram of Fig. 2, consisting of two graduated scales and a network of two systems of numbered lines. Each scale and each system of lines represent the numerical values of certain selected variables; in the case illustrated, the scales carry values of the variables p and q, while the network of lines represent values of r and s. It is easy to see that, if the two particular lines on the network corresponding to given values of r and s be taken and their point of intersection noted, this point in turn may be used as itself lying on the index line which aligns the value of p and q on the external scales. The four variables are thus correlated by one application of the index line. The procedure is perfectly general, and if any three of the variables are given, the value of the fourth may at once be found. Thus, if the values of p, q and s were known, that of r would be read at the intersection of the line joining p and q with the particular line on the network associated with the given value of s.

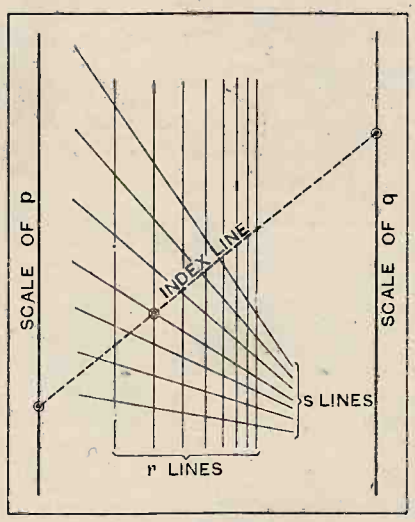

Fig. 2.—Scheme of four-variable alignment chart. A single application of the index line relates the values of p and q with those of r and s.

The simplicity of this operation will be appreciated. The network of lines for r and s need not, in the general case, be the rectangular cartesian network of horizontal and vertical lines. On the contrary, it may consist of any ordered sequence of lines, or even of curves, depending on the formula which is to be illustrated. The values represented by each line of the network should, however, be easily readable, so that intermediate values between the numbered curves or lines can readily be interpolated by eye. The actual construction of the network which will now be described will not be discussed here, as being essentially a question of pure mathematics, and as such, rather outside the province of these pages. Detailed measurements will, however, be gladly supplied to anyone interested on enquiry through *The Wireless World* offices.

Alignment Chart for Impedance of Resistive Inductance.

The Alignment Diagram of Fig. 3 has been prepared on the above principle to illustrate the impedance z of the resistive inductance shown in Fig. 1 for varying values of L, R, and f. The two external scales are those of resistance and inductance, the values of R shown extending from 0 to 6,000 ohms, while those of L extend from 0 to 2 henrys. The intervening network of lines consists of a series of parallel vertical lines representing values of frequency from 50 to 3,000 cycles per second, while across these run a diagonal series of sloping lines representing values of impedance up to a maximum of 30,000 ohms. It will be observed that the lines of lower impedance values (below 6,000 ohms) meet the external resistance scale in the same numerical values as they themselves carry.

The method of using this chart to arrive at the value of any one of the four variables concerned when the

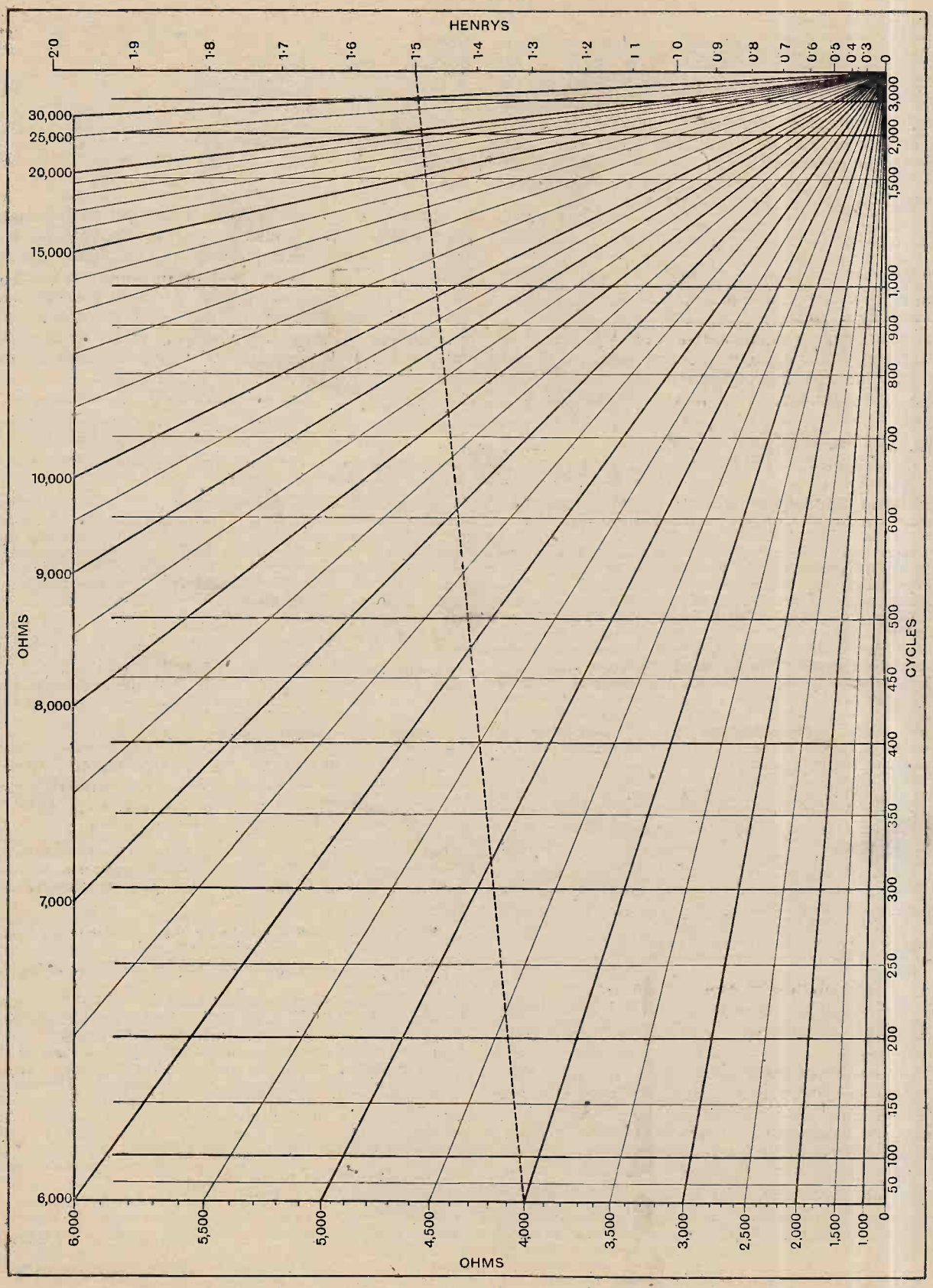

Fig. 3.—Four-variable alignment chart for impedance of an inductance in series with a resistance. The index line shows the case when L = 1.5 henrys, R = 4,000 ohms. At 400 cycles, the impedance is approximately 5,500 ohms.

Loud Speaker Impedance.—

other three are known has already been outlined above. *The index line through the values of R and L on the outer scales will always pass through a point on the network which gives at once the impedance and the frequency with which this impedance is associated.* Hence it follows that, if the values of R and L are known for the circuit of Fig. 1, the corresponding impedance-frequency graph of the circuit may be derived by a single application of the index line.

TABLE.

Coil Impedence for L = 1.5 H., R = 4,000 Ω at various frequencies.

f (cycles)	100	200	300	400	500	600	700	800	900	1,000
z (ohms)	4,100	4,400	4,900	5,500	6,200	6,900	7,700	8,500	9,400	10,200

As an example, we shall suppose a coil whose inductance of 1.5 H. and resistance of 4,000 ohms are known to be constant and independent of the working frequency. The resultant index line is shown dotted in Fig. 3, and by means of it the values of impedance for frequency as given in the accompanying table are quickly found.

These values may be checked by reference to equation (1), for example, when $f = 400$,

$$z = \sqrt{(2\pi \times 400 \times 1{\cdot}5)^2 + (4{,}000)^2}$$

$$= \sqrt{30{\cdot}21} \times 10^3 = 5{,}500 \text{ ohms.}$$

The labour-saving utility of this chart in the direct revaluation of z is thus considerable; its uses are, however, by no means confined to this alone. In the next part of this article it is hoped to show how it may, by an inverse process, be used to derive the values of R and L in cases where these are unknown, and furthermore to adapt the procedure to the case when, as with the loud speaker, both resistance and inductance vary with the working frequency.

(*To be concluded.*)

New Books.

The Elementary Principles of Wireless Telegraphy and Telephony.—By R. D. Bangay. Revised by O. F. Brown, M.A., B.Sc. Third Edition. Price 10s. 6d.

This is a revised version of a book whose earlier editions have proved to be of great value to the beginner in wireless telegraphy and telephony. The present edition, revised by O. F. Brown, M.A., B.Sc., of the Radio Research Board, is brought up to date by the addition of material to the book, as a continuation to Bangay's own work. The first twelve chapters constitute almost entirely the work of the original author and deal in his characteristically lucid manner with the elementary principles of electricity and magnetism, the theory of dynamos and transformers, the properties and production of waves and high-frequency oscillations, telegraph receiving apparatus, aerials and masts. The subject-matter of this portion of the book relates chiefly to spark telegraphy and damped oscillations, valves and valve circuits not being included.

The reviser has added 114 pages relating mostly to valves and valve circuits. A remarkably wide field is covered in the fifteen chapters appended by the reviser. Among other items, chapters are devoted to a review of alternating-current theory, principles of thermionic valves, valve amplifiers and detectors, radio transmitters, H.T. eliminators, loud speakers, and radio direction finding. The meaning of and inter-relationships between the various constants of a thermionic valve are explained in a particularly simple manner. In fact, the phraseology throughout is clear and to the point and likely to be easily understood by the novice. It seems rather unfortunate that in a number of diagrams relating to valve amplifier circuits no provision for grid-bias is indicated. Chapter XXI, entitled "Design of the Complete Radio Receiver," is a discussion of the salient points of a typical receiver, but no actual design is worked out, though the circuit diagrams and constants of some representative *Wireless World* receivers are given at the end of the chapter.

The book can be recommended as one giving reliable information in the simplest possible language. It is published by Iliffe & Sons Ltd. at the price of 10s. 6d.

S. O. P.

The Wireless and Gramophone Trader Year Book and Diary, 1931.—This invaluable publication, while retaining most of the features which have proved of such great service in previous issues, has introduced into the technical section an article by the Technical Editor on "Practical Service Methods," which gives in a clear manner the information which the trader is likely to need in the ordinary course of his work when testing for faults or when called upon to meet the many problems which may confront him in the performance of service work. The Directory section has been carefully revised and, as usual, contains the names and addresses of manufacturers, in alphabetical order, publishers, associations, factors, proprietary names of various components, and a classified list of the manufacturers and suppliers of all kinds of wireless and gramophone apparatus. Pp. 380. Published by The Trader Publishing Co., Ltd., London, E.C.4. Price 5s. 6d. post free in Great Britain or 7s. 6d. overseas. Issued at a reduced price to subscribers of the "Trader" journals.

The B.B.C. Year Book, 1931.—This issue follows fairly closely the general lines established last year, including the principal events broadcast from November 1st, 1929, to October 31st, 1930. There are numerous short articles of interest on subjects connected with the preparation and production of programmes, music, drama, and talks. The Technical Section contains excellent advice on the choice and maintenance of receivers and information concerning the various stations, the acoustic properties of the studios, etc. Pp. 464, with numerous illustrations. Published by the British Broadcasting Corporation, London, W.C.2, price 2s.

Testing Radio Sets.—By J. H. Reyner. Section I comprises Fault Testing, showing the method of systematically tracing breakdowns or defects in receivers, and Section II is devoted to Laboratory Tests. Pp. 178, with 88 diagrams and illustrations. Published by Chapman and Hall, London, price 10s. 6d. net.

Motor Cycles and How to Manage Them (25th Edition).—Completely revised and rewritten by the technical staff of *The Motor Cycle*. Pp. 232+xix, with 176 illustrations and diagrams. Published by Iliffe and Sons Ltd., London, price 2s. 6d. net or 2s. 9d. post free.

The Electrical Educator (Second Edition).—Edited by Sir A. Fleming, M.A., D.Sc., F.R.S. This publication, which is being issued in twenty-eight fortnightly parts, is the combined work of a large staff of experts and specialists, and covers the whole field of Heavy Current Electrical Engineering, with special sections on wireless subjects. In its complete form it will comprise about 1,500 pages, with many diagrams and illustrations. Part I includes a chapter on the Education of Electrical Engineers, eleven chapters on Electricity and Magnetism, and the preliminary pages on Direct Current Dynamos. Part II will be ready on October 18th. Published by Sir Isaac Pitman and Sons, Ltd., London, price each part 1s. 3d. net.

Photo-Electric Cells and Their Application.—A discussion at a joint meeting of the Physical and Optical Societies, including the early history, theory, standardisation, manufacture, application and scientific study of photo-electric cells. Pp. 236, with numerous diagrams and illustrations. Published by the Physical and Optical Societies, London, price 12s. 6d.

NOISY LOUD SPEAKER: HEAVY FINE.

For "flagrant disregard" of the feelings of neighbours, W. A. Cromwell, a Kensington electrician, has been fined 40s. with three guineas costs. Cromwell had operated a loud speaker in a manner causing annoyance to occupiers of West Kensington Mansions.

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THAT OLD ACCUMULATOR.

Readers who have no further use for their worn-out accumulators may be interested to know that these "white elephants" can realise money for the hospitals on account of the lead which they contain. Mr. S. C. Knott, of the Middlesex Hospital, Mortimer Street, London, W.1, would be glad to receive gifts of old accumulators or the lead plates extracted from them.

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COLOUR TELEVISION.

"Television in Natural Colours" is the title of a lecture to be given by Mr. T. Thorne Baker, F.Inst.P., A.M.I.E.E., at a meeting of the Television Society on December 10th, at 7 p.m., at University College, Gower Street, W.C.1.

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INTERNATIONAL LISTENING TEST.

An International Listening Competition is being organised by the Radio Club of Cannes, and British listeners are invited to participate. For the purpose of the test, which takes place on Sunday, December 14th, special transmissions will be made on 45, 78, and 175 metres. Competitors will be required to complete a reception form giving particulars of the words spoken and the names of pieces of music broadcast. Readers interested can obtain entry forms and full information on application to the Radio Club, 11, Square Mérimée, Cannes.

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KEEPING THE WOLF FROM THE DOOR.

The best story of the week comes from Siberia. Here, on the icy Steppes (writes a correspondent), armies of voracious wolves sweep down upon the villages. In the past their approach has been heralded by the cries of individual watchers warning the villagers to get ready for the onslaught. Now, however, these watchers can spend their time more profitably. Microphones are suspended from the trees on the outskirts of the villages, and, as the wolves draw near, their growls are picked up and heard on receivers in the villages.

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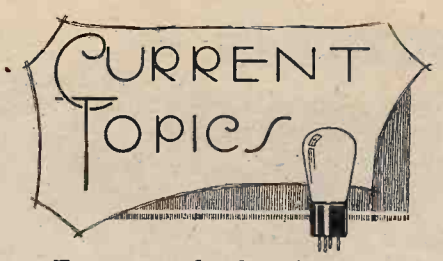
BROWN RECEIVERS.

Messrs. S. G. Brown, Ltd., draw our attention to the fact that their receivers were listed in *The Wireless World* Buyer's Guide at the old prices. The following price reductions have been made :—

	Old Price.			New Price.		
	£	s.	d.	£	s.	d.
DORCHESTER SETS.						
6-volt type	45	0	0	35	0	0
Permanent magnet ...	47	0	0	37	0	0
A.C. or D.C.	48	0	0	38	0	0
GROSVENOR RECEIVERS:						
6-volt	17	17	0	14	14	0
Permanent magnet ...	20	0	0	16	16	0
A.C.	21	0	0	17	17	0



Events of the Week in Brief Review.

ITALIAN LISTENING POSTS.

Italy now possesses two official listening stations similar to the B.B.C.'s station at Tatsfield. They are situated at Milan and Sesto Calende respectively, writes our Turin correspondent. Besides guarding the wavelengths of the Italian stations, the control posts contribute to the programmes by means of international relays.

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INTERVAL SIGNALS.

Elsewhere in this issue will be found a reference to the B.B.C.'s proposed interval signal for use during comparatively long periods of silence between items. It has now been suggested to us that there may still be time for the B.B.C. to improve upon the rather unoriginal notion of a clock tick. What would be much more valuable would be an identification signal in the form of a continuous note of increasing and diminishing intensity, easily producible by a sound-emitting pendulum screened from the microphone during a portion of its swing.

The problem of a suitable interval signal has been perturbing the officials at the Rome Broadcasting Station, and an appeal for suggestions was recently issued, writes a correspondent. More than 370 proposals have resulted, but not one of them has been considered to be in keeping with the dignity of the Eternal City.

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AMERICA'S ELECTRICITY SUPPLY.

Lack of uniformity in the public electric supply seems to be causing as much trouble to mains set users in America as in this country. According to our Washington correspondent, no fewer than twenty different voltages are used in the U.S. The majority of American all-electric sets are built to operate on 110-volt 60-cycle A.C., yet there are large D.C. sections in the big cities.

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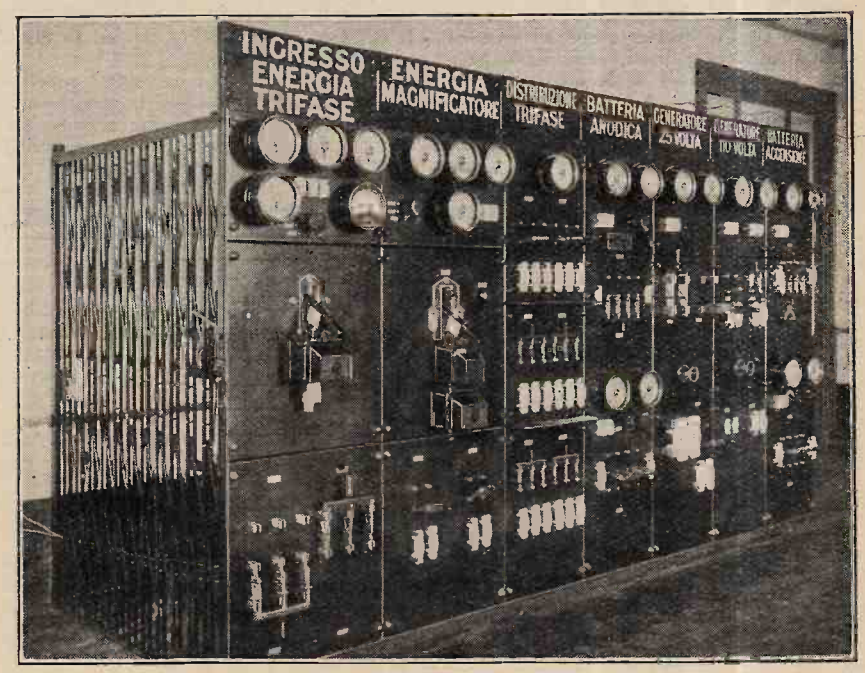
"THE DAILY TELEGRAPH" AT A 1d.

Singe Monday last the *Daily Telegraph*, which celebrated its jubilee only a few weeks ago, has reduced its price to the pre-War figure of one penny. During recent years not only has it steadily improved its contents, both literary and pictorial, but it has replaced its printing machinery by the most modern plant, and its offices, one of the landmarks in Fleet Street, have been rebuilt and rearranged throughout.

The paper has always been in a class of its own. As a daily newspaper it has become a characteristically British institution—just the kind of paper with which the typical English man and English woman like to start the day, sure that they can find in it all the news, given adequately, accurately and without distortion, in an attractive, well-arranged way.

Its many friends will wish that at its lower price, which involves no change in form, size or policy, it will enjoy still greater prosperity.



SHORT WAVES FROM ROME.—The switchboard at Radio Smeraldo, Rome. the 9 kW. station which can be heard in this country on 60 metres. The call sign is 3 RO.

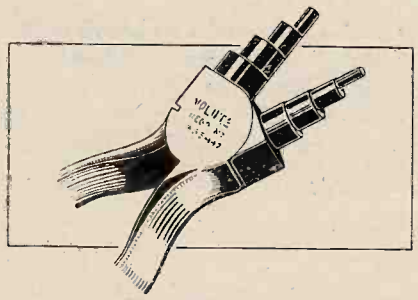
WIRELESS WORLD

LABORATORY TESTS

A Review of Manufacturers' Recent Products.

VOLUTE PLIERS.

In the average home-constructed receiver soldered joints and connections made by nuts and screws appear in about equal proportions, while in some kit sets the last-mentioned method is used exclusively. To make truly circular loops at the ends of the leads, and of the correct form to fit the various standard sizes of screws commonly used, requires experience when ordinary tools are employed, but with the aid of the special Volute loop-forming tool it becomes a very simple matter.



Volute pliers, a labour-saving tool for making loops in wire.

The pliers are provided with two stepped jaws, each jaw carrying four steps, circular in section and decreasing in diameter from the base to the point of the jaw. The steps are arranged eccentrically so that the two inside faces of the jaws are parallel. It is possible to make eight different sizes of loops, since the steps on one jaw are of different diameter from those on the other. In addition, a wire-cutter is provided on one side of the tool.

The pliers are supplied in cartons, each containing two instructional leaflets, one of which is illustrated and contains many useful hints concerning the manipulation of the tool. The makers are the Volute Pliers Co., 19, Victoria Square, London, S.W.1, and the price is 4s.

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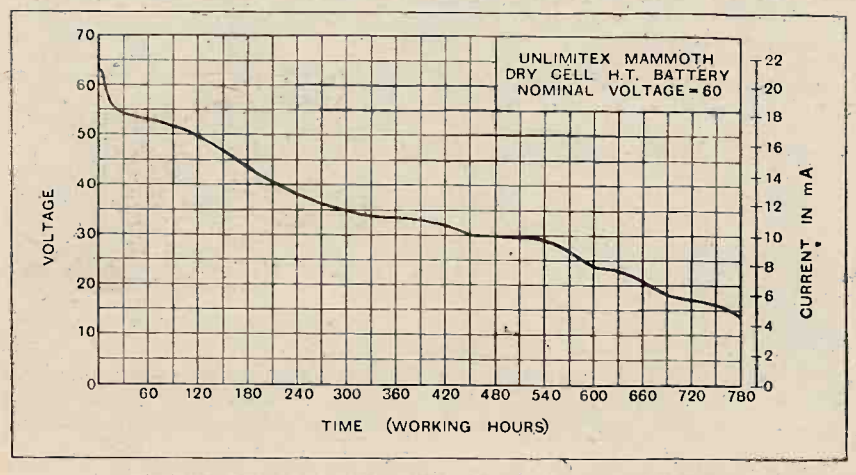
UNLIMITEX MAMMOTH H.T. BATTERY.

This is styled a "triple-capacity battery," its particular feature being that it will withstand comparatively heavy discharge, such as that occasioned by the use of a super-power valve in the output stage of a receiver. Its nominal voltage is 60, the battery being tapped in steps of 6 volts throughout.

In accordance with our usual practice the battery was discharged intermittently, periods of four hours being allowed for recuperation between each 4-hour period of discharge. The rest periods are not included in the discharge curve, the actual working hours only being shown.



Discharge curve of the Unlimitex "Mammoth" dry cell battery.

In view of its capacity it was decided to commence the discharge at 20 mA., but as the initial terminal E.M.F. was 63 volts, the 3,000-ohm loading resistance allowed 21 mA. to pass at the beginning.

During the first few hours the voltage fell rather rapidly, but eventually reached a more steady value, and from thence onward the decline was gradual. There is no well-defined cut-off point. In most cases it is usual to keep the battery in commission until the voltage per cell drops to 0.9, which, applied to the battery under discussion, gives approximately 240 hours' useful life. Regarded as actual capacity, this yields about 5,300 mA. hours: assuming an initial discharge of 20 mA., the E.M.F. of the battery will have fallen to 38 volts.

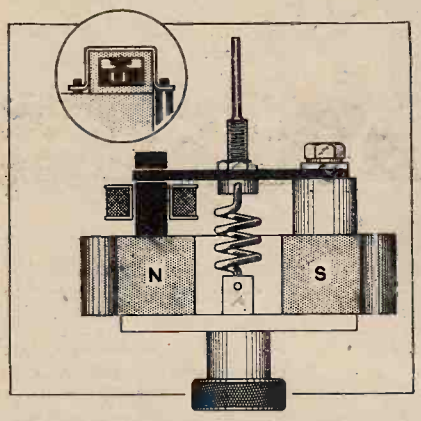
Unlimitex "Mammoth" triple-capacity H.T. battery: nominal voltage 60.

The battery is not yet moribund, and still has many mA. hours in it, but a boosting battery will be required to raise the voltage to the level required to operate the set in a satisfactory manner. Assuming it is kept in commission until it shows 0.75 volts per cell, it will afford some 425 hours of work and furnish about 7,900 mA. hours' actual capacity.

These batteries are of German manufacture, and are distributed in this country by Wireless Supplies Unlimited, 278, High Street, Stratford, London, E.15. The price of the Mammoth size is 14s. 9d., and they are available only direct from the concessionaires at the above address. Mail order business is not handled.

COLASSION "JUNIOR" LOUD SPEAKER.

This model is the smallest in the range of "Colassion" loud speakers, many of which are designed for public address systems and cinema equipments. The



Constructional details and arrangement of pole pieces in the Colassion "Junior" unit.

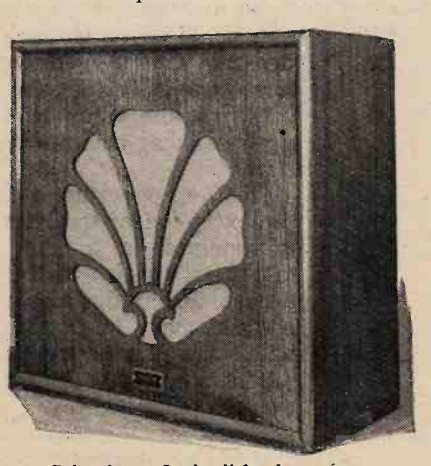
cabinet is constructed of $\frac{7}{8}$in. solid oak with the object of reducing box resonance, and the overall dimensions are $19\frac{3}{4} \times 19\frac{3}{4} \times 10\frac{1}{2}$in.

The movement consists of a "T" type reed, the tip of which vibrates inside a laminated iron pole structure with opposing pole faces. The permanent magnet is of unusually massive construction, and the workmanship of the unit as a whole is of a high order.

The measured impedances of the windings at octave intervals over the useful frequency range were as follow :—

Frequency.	Impedance (ohms).
50	1,800
100	2,790
200	4,000
400	5,620
800	11,350
1,600	33,500
3,200	41,800
6,400	53,000

The loud speaker was tested over a



Colassion "Junior" loud speaker in oak cabinet.

range of frequencies from 50 to 6,000 cycles, and, while a response to all frequencies within these limits was obtained, the output above 4,000 cycles and below 100 cycles was below the average. The response was greatest between 100 and 350 cycles, but from 400 to 4,000 cycles the output was practically constant. Comparisons with other loud speakers showed that the sensitivity is slightly above the average.

The power required to cause the reed to chatter in the neighbourhood of the base resonance was approximately 480 milliwatts, but considerably greater powers could be handled at frequencies above 400 cycles.

The loud speaker is made by W. L. Colassi, Mark Lane Station Buildings, London, E.C.3, and the price is £5.

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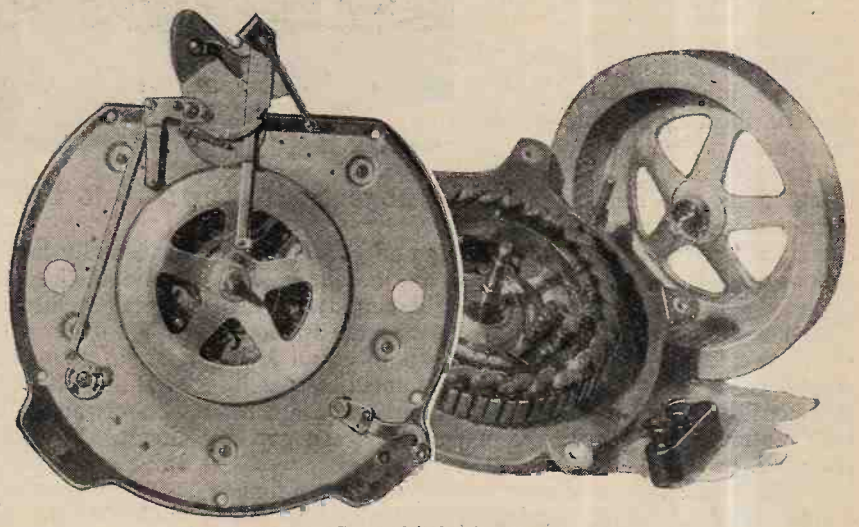
GARRARD GRAMOPHONE MOTOR.

In the recent description of *The Wireless World* Four where a chassis was used in the construction of a radio-gramophone, mention was made of the Garrard gramophone motor. Attention has been drawn by the Garrard Engineering and Manufacturing Co., Ltd., 17, Grafton Street, New Bond Street, London, W.1, to their latest type of motor which they recommend as suitable for building into the cabinet and chassis arrangement described. There is plenty of room for the inclusion of the new Garrard induction type motor, particularly as the depth of the new model is only $3\frac{1}{2}$ in., as against $5\frac{1}{2}$ in. for the Universal motor which was shown in the set.

An outstanding feature of the Garrard Induction motor is that of steady running which is essentially due to the fact that the revolving magnets are diecast into an aluminium rotor, and when the revolving weight, which is no less than $4\frac{1}{2}$ lb., is in motion, a flywheel effect is applied to the turntable, which maintains an even torque. Thus, there is no tendency for the turntable to be retarded on exceptionally heavy passages of the gramophone record. The temperature rise in this induction motor is extremely low, and there is only about 25° C. change after three hours' running, and this is not exceeded after a further five or six hours' continuous work. A useful point is that the motor is oiled through the centre spindle, so that careful attention can be given to lubrication without the need for gaining access to the interior.

The construction and finish of this motor are particularly attractive, and the many novel details of design will make a strong appeal to the enthusiast who has an appreciation for a really first-class job. It is one of the few motors provided with a top plate on which the entire mechanism for regulating and automatic stopping is assembled. For a motor of this class the price, £4 17s. 6d., is attractive.



The new Garrard induction type motor.

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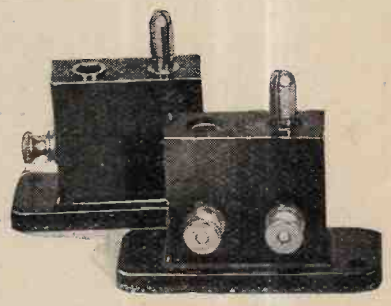
"CRITIC" COIL HOLDER.

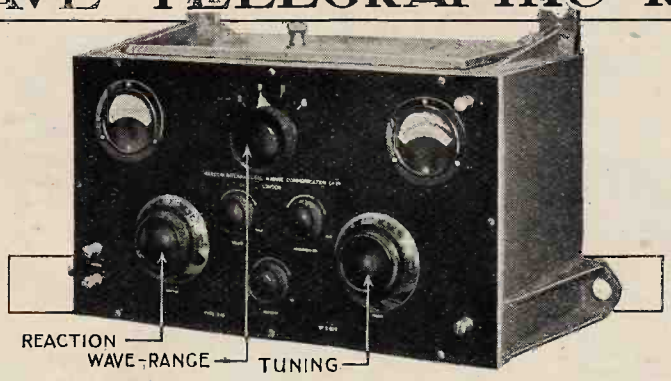
This coil holder is moulded in high-quality bakelite and designed as a baseboard mounting for the plug-in type of coil. There are two kinds available, one



Two types of bakelite coil mounts made by Franklin and Freeman, Ltd.

with the terminals on the broad face and one with the terminals located at the side. The price is 9d. each for either pattern, and the makers are Franklin and Freeman, Ltd., 17-19, Finsbury Street, Finsbury, London, E.C.2.

SHORT-WAVE TELEGRAPHIC RECEIVER



Wave-range Switching: 14 to 100 Metres.

ALTHOUGH the Marconi Type 372 receiver is intended primarily for telegraphic work on board ship, it seems likely that a description of its leading features will be of interest to those amateurs who concern themselves with short-wave reception.

The set is designed for quick, easy, and certain operation in circumstances where the missing of a message might well have serious consequences. As shown in the accompanying circuit diagram, a screen grid valve is employed; this is intended to act rather as a buffer between the aperiodic aerial circuit and the tuned coupling than as an H.F. amplifier. A series aerial condenser, shunted by a static leak, is fitted, and, to afford further protection against heavy atmospheric discharges, a parallel spark gap is provided.

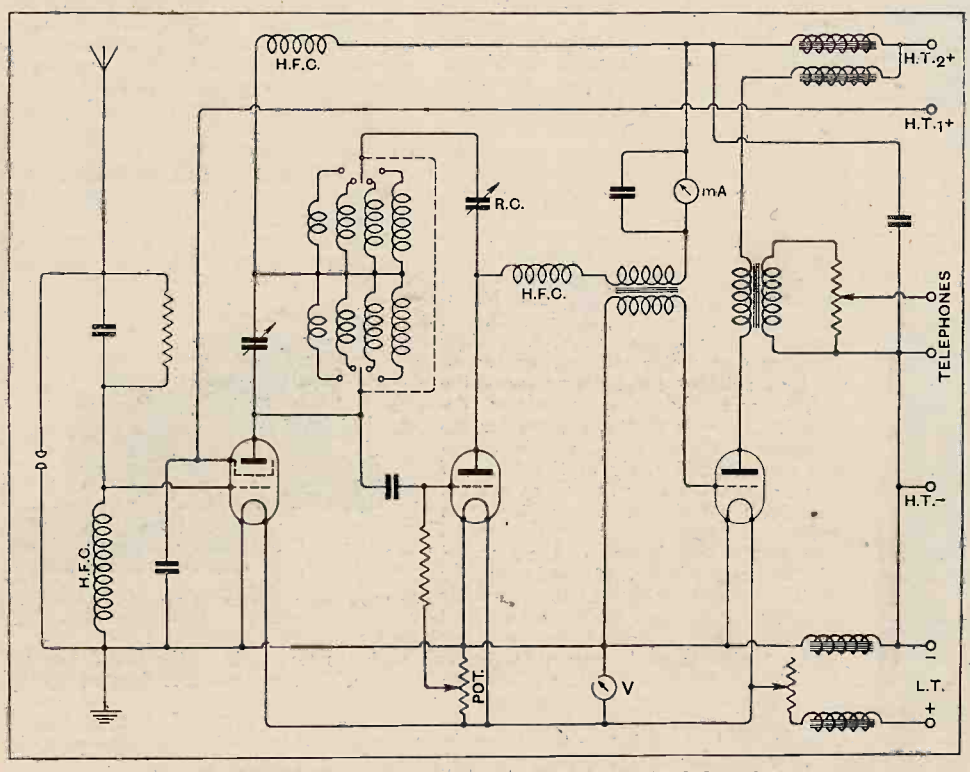
Four separate coil assemblies, each comprising a tuned winding and a reaction section, are provided for the H.F. valve anode circuit; any one of these assemblies may be connected by means of a double-pole wave-range switch. The succeeding oscillating grid detector is coupled to the L.F. valve by a transformer, and volume is controlled by a potentiometer across the output transformer secondary.

Smoothness of reaction control, which is effected by means of a variable condenser, is considered as all-important; the screen grid valve, which incidentally largely prevents radiation, helps to a great extent in this matter by removing the aerial load, but several additional precautions are taken. In the first place, there is the usual detector grid potentiometer, and, to allow what are found to be the best operating conditions for this valve to be subsequently duplicated with certainty, a milliammeter is joined in its anode circuit. Further, an H.F. choke is inserted in the S.G. valve anode circuit.

To prevent induction interference, chokes are placed in the battery feed leads; with regard to the filament circuits, these chokes have of necessity a sufficiently high resistance to make it essential to fit valves of a lower filament rating than the voltage of the L.T. battery. The actual filament voltage is shown by meter, and is regulated by means of a rheostat. As an extra precaution against unwanted noises, tuning is effected by a double condenser having no external metallic connection to its two sets of moving vanes. In effect, two condensers with a common metallic spindle are joined in series, the circuit connections being made to the stators.

All the apparatus, with the exception of batteries, is mounted in a strong cast-metal case. Matters are so arranged that the chassis may be readily withdrawn for inspection.

This illustrated description is published by the courtesy of the makers, Marconi's Wireless Telegraph Company, Ltd.



Complete circuit diagram. Valves are Marconi S.215, H.L.210, and L.210.

BROADCAST BREVITIES

By Our Special Correspondent.

Poor Welcome for Muhlacker.

Looking at it from a technical point of view the B.B.C. engineers are not inclined to extend friendly greetings to Muhlacker, the new German transmitter on Stuttgart's old wavelength of 360 metres. To have a 75 kW. transmitter suddenly bellowing forth only 9 kilocycles from London Regional seems to be inviting trouble, and I am surprised that the jamming observed by Regional listeners since November 21st, when Muhlacker opened, has not been greater.

oooo

French Hostility.

France is not disguising her hostility to this powerful station situated so near the frontier, while Bergen and quite a number of other small stations which adjoin Muhlacker on the kilocycle scale are beginning to complain bitterly.

oooo

London Regional Threatened.

The latest development amounts almost to a cat-and-dog fight between Muhlacker and Strassbourg-Brumath, the newly opened transmitter in Alsace-Lorraine. Both are frontier stations, and each is shouting at the other. The danger is that, as the battle waxes hotter, London Regional will suffer the usual lot of the peaceful onlooker and receive the worst blows!

oooo

A Conference in Paris.

The power of Muhlacker and its potentialities for jamming are forming the centre of discussion at a meeting summoned in Paris by the Technical Section of the Union Internationale de Radiofusion. The B.B.C. is represented at the meeting, and can be relied upon to look after the interests of British listeners. The Bureau is being asked to raise the German station's wavelength.

oooo

Have You Noticed It?

The B.B.C. report that they are receiving more letters than usual relative to fading on the Daventry long-wave transmissions. Some writers maintain also that distortion sets in after nightfall.

The bulk of the complaints come from Cornwall, North Wales and the Lake District.

oooo

"All-Welsh" Again.

Every month or two someone in Wales springs to his or her feet and demands an "All-Welsh" broadcasting station. No one has ever asked for an "All-English" station or even, for that matter, an "All-Scotch" station; but an "All-Welsh" station, apparently, there must be.

I drew the attention of a B.B.C. official to the fact that Lady Grey put in a plea for such a station at a Liverpool meeting on November 21st.

oooo

The B.B.C. Reply.

"Of course, there will be no 'All-Welsh' station," he said. He explained that the Western Regional station would pay due attention to the needs of the Welsh people; certain of the transmissions on one of the twin wavelengths would probably be in Welsh, but there could be no guarantee of a station committed to the exclusive service of only a proportion of its listeners.

oooo

Amos 'n Andy.

Amos 'n Andy, the comic pair who have taken listening America by storm through their microphone and screen appearances as blackfaced companions in distress, are to be relayed for the benefit of British listeners on December 31st. The B.B.C. will take the Amos 'n Andy "turn" on the U.S. National Broadcasting Company's network via the Transatlantic Telephone service.

oooo

The American Language.

Judging by the excellent relay of the Harvard-Yale football match a few days ago, British listeners should have no difficulty in hearing Amos 'n Andy, though whether these American comedians will be intelligible over here is another question. However, our powers of comprehension will not be strained if we have enjoyed a good "talkie" education.

oooo

A Revival.

A revival of that thrilling play, "The Flowers are not for You to Pick," which was specially written for the microphone by Tyrone Guthrie, will be broadcast on the National wavelengths on December 18th and on the Regional wavelengths on December 19th.

Mr. Guthrie was the author of "Squirrel's Cage," which introduced a new form of studio technique last year.

oooo

A Relay from Poland.

The first relay from Warsaw will be heard by Regional listeners on December 17th, a Polish National Programme having been arranged specially for that evening.

oooo

The "Science and Religion" Series.

The twelfth and last of the series of talks on "Science and Religion," which are broadcast nationally on Sundays, will be given on December 14th by Dr. L. P. Jacks, of Manchester College, Oxford. He is the author of many books and articles on religious and philosophical subjects.

oooo

Ideas for the Interval Signal.

So the B.B.C. can think of nothing more original for the proposed interval signal than the ticking of a clock. What an opportunity they are missing!

Use might be made of a continuous gramophone record breathing soft phrases concerning oscillation or the penalties attaching to unlicensed listening. It would be wise, of course, to confine the interval calls to unpleasant topics lest listeners should begin to prefer intervals to programmes.

oooo

A Permanent Call?

A distressful letter reached Savoy Hill last week from a listener who evidently imagined that the interval signal would be broadcast at all times when the B.B.C. were not sending out programmes.

"This," he wrote, "will make it more difficult than ever to pick up foreign stations."

The idea is a horrible one. I hope the B.B.C. won't ponder over it.

"FUNKHAUS." A new view of the German broadcasting authorities' headquarters in Berlin, to be opened before the end of the year. The building is one of the largest to be erected in the capital in recent years and has a frontage of 168 yards. On the roof is a terraced garden available for concerts.

Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

BROADCASTING GRAMOPHONE RECORDS.

Sir,—I heartily agree with Mr. Dunn's recent letter in the *Wireless World*. Fortunately, the best gramophone record reproduction is not up to the best radio reproduction, and it is always possible to detect when records are being broadcast. At the very best, the gramophone can only produce "canned" music, and is devoid of that personal touch which makes ordinary radio so effective in its appeal. By all means have a certain amount of gramophone, but, in the name of all that's artistic and sincere, I hope your journal will oppose any tendency to substitute the mechanical gramophone for the personal performance in the studio. P. G. CUSDIN.

Hanwell, W.7.

SCOTTISH BROADCASTING.

Sir,—About five years ago listeners hereabouts were in a position to choose between three programmes—Glasgow's, Aberdeen's, and, from Edinburgh, London's. Two of these stations had an orchestra of sorts; the relays had, at least, sufficient staff to form Children's Corners of their own, and the quality of the transmissions was quite good enough for our sets.

Nowadays, we have a (so-called) "studio orchestra" in Edinburgh, and a Children's Hour staff, which suffices for the whole of Scotland, whilst the vocalists may be in Edinburgh, Aberdeen, or Glasgow, communication being established by land-line. The quality over these local lines is, at times, positively atrocious.

So much, then, for the fare served up. It will be seen that the economy axe has been wielded with a vengeance. As regards the transmitters, Aberdeen's signal has vanished, and Edinburgh's is lost in a continuous noisy gurgle. Thus, only Glasgow remains; and, to be frank, I have given up Glasgow as a hopeless proposition at fifty miles' range. From no other station do I get such an appalling upper register; it defies flat tuning, band-pass filters, rising characteristics—defies all the known remedies. In addition, after dark it often more or less disappears in the mush.

Meantime, we read of huge orchestras being formed, and of giant buildings being erected; or, now and again, we tune in the London Regional, or 5GB, and enjoy for a brief interval the flesh-and-blood quality which *can* be obtained. Only lack of cash, we are told, prevents our own stations from coming into being; furthermore, personal reflection tells us that we will be lucky if we are rewarded in less than two years' time.

I hold that lack of cash should present *no* obstacle to a concern of such a standing as the B.B.C. It isn't as if merely a few listeners were involved; since the effective range of a relay station is only three miles (and at twelve miles from the Scottish capital I can well believe it) then practically the whole of Eastern Scotland is affected. For my part, technical interest, and nothing else, is responsible for the fact that I am still a licence-holder. J. NICOL.

Kirkcaldy, N.B.

RADIO SERVICING.

Sir,—In your editorial comment on "Radio Servicing" in the issue of October 22nd you mention that "any proposals which may tend to simplify the problem of servicing should be given the full attention which the subject deserves," and I therefore suggest that the following points are worthy of mention in your columns.

It was the obvious inadequacy of the radio servicing available which led to the Radio Association introducing its national set maintenance scheme to the listening public on September 1st. Under this scheme England and Wales has been divided into small areas, in each of which we have appointed one or two representatives who are prepared to call at any time on any member of the Association who has a faulty receiver and make any necessary adjustments free of charge. We are represented in the majority of districts by a reputable wireless trader, and in others by a radio engineer operating from his private address. In either case careful enquiries have been made by us as to the standing and ability of the representative, several references being taken up in most instances.

Every listener in England and Wales who pays the annual subscription of six shillings only to the Association is registered on the "panel" of our local radio doctor and supplied with special printed postcards. When the set develops a fault one of these cards is posted off immediately, and our representative calls and makes any minor repairs or adjustments on the spot free of charge. Actual replacements are charged for at normal list price. In the event of any member being dissatisfied with the service rendered they have a central organisation, which includes a legal department under the control of a solicitor, to whom they may voice their grievance.

RONALD F. TILTMAN.
General Secretary.

Radio Association, 22, Laurence Pountney Lane, E.C.4.

POWER DETECTION.

Sir,—Mr. P. K. Turner's letter, which you have headed "Power Detection" in the October 8th issue of *The Wireless World*, is very interesting. We are obviously much indebted to him for demonstrating the superiority of grid detectors and for investigating the proper conditions for satisfactory performance.

I do not intend to dispute his claim to be the first to prove the superiority of grid rectification, but, in this connection, perhaps it may be of interest to note that as far back as 1926 Mr. L. B. Turner had an article in *The Electrician* of September 10th and October 8th, 1926, in which he shows that the grid rectifier need not produce a perceptible top cut-off, and expresses the opinion that grid recification is at least as good as anode rectification. R. ST. Q. LENG.

London, W.1.

BRITISH RADIO EXPORTS.

Sir,—I have considered the writing of this letter for a long time, and have postponed it in the hope that at least some of the British radio manufacturers would wake up. Apparently, few of them have any idea that the Argentine is a potential market, and has been for some years.

In view of the forthcoming British Exhibition, which is to be held in Buenos Aires during March and April next year, couldn't some of them get together and show the Argentine that America is not the only country that manufactures radio material? So far as I can make out, from the little British stuff that is on sale here, the only people represented are:—

The General Electric Company, Ferranti's, Brown's, Benjamin Electric Co. (through G.E.C.), Graham's and T.C.C.

It may seem surprising, but there are more British-type valve-holders of Scandinavian origin sold than any others. As for the rest of the components, we have a majority of American stuff. Even the above-mentioned firms do not advertise extensively, and it is usually by chance that one sees their materials in shop windows. Up to a point it can be understood, as either radio is a sideline with them, or else the agency is in the hands of an importer who has far too many more lucrative agencies on his hands to worry about one

In case the readers of this letter (should it be published) imagine that we are backward in radio matters, I enclose an extract from the *Buenos Aires Herald* which gives a list of broadcasting stations around the town as well as a list of the regularly received short-wave stations.*

Surely it is time Britain did something to obtain foreign trade, instead of moaning about it, and reading its unemployment figures? A. HILDRED.

Buenos Aires, Argentine.

* [The list gives 19 broadcasting stations and 6 short-wave stations, including 5 S.W.—ED.]

READERS' PROBLEMS

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

A Valve Oscillator.

I should like to construct a valve oscillator for use in experimental work, and have decided to use fixed magnetic coupling between plate and grid circuits. There does not seem to be unanimity as to which of these circuits should be tuned. Will you please advise me on this point?

S. W. R.

It is generally preferable to tune the plate circuit, as it is now realised that the output of an oscillator valve arranged in this manner will be more free from undesirable harmonics than when its grid circuit is tuned.

oooo

Lamp Resistances.

In a modern mains-fed receiver there is often occasion to use resistances with values of 2,000 ohms or so; calculation shows that the filaments of ordinary lamps have resistance values of this order. As these lamps can now be obtained very cheaply, would it not be possible to use them?

B. G. W.

We cannot agree that the use of lamps as resistances is likely to be generally satisfactory. The resistance of a lamp, as ascertained by calculation when using its voltage and wattage rating as a basis, will only be correct when the filament is glowing at its normal brilliancy; when it is cold its resistance may be one-tenth of that value. Further, if the current passing through the filament were sufficient to raise its temperature to, say, a dull red heat, its actual resistance would be somewhere between the "cold" and "hot" values, and there would always be uncertainty.

oooo

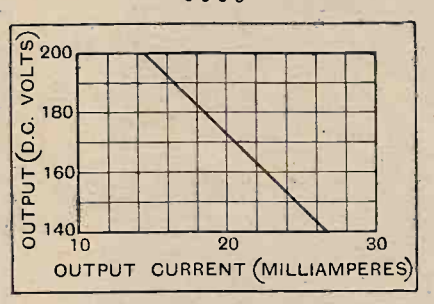


Fig. 1.—An eliminator regulation curve, showing relationship between output voltage and output current.

Interpreting a Regulation Curve.

I have just ordered an Atlas Combined Eliminator, as reviewed in your issue of November 12th, and should appreciate a word of advice as to the best way of using it. My three-valve set includes a screen-grid H.F. valve, transformer-coupled to a grid detector, which is followed by a power valve, also transformer-coupled. Both the H.F. and output valves are rated at a maximum anode voltage of 150, and I propose to feed these from the "power" output terminal; the screening grid will be connected to H.T.+1 (through the internal eliminator potentiometer), and the grid detector will be fed through the H.T.+2 terminal. It is assumed that, as tuned anode coupling is not employed, there will be no harmful interaction between the H.F. and output stages.

My output valve is supposed to consume 12 milliamps at its maximum rated anode voltage when normally biased, and, so far as I can see from your description of the eliminator, this valve will receive an excessive voltage unless a feed resistance is included. Will you please tell me how its value should be calculated?

G. M. M.

Your proposed method of connection should be quite satisfactory, and, as you say, it would perhaps be as well to insert a voltage-absorbing resistance in the common feed lead for the H.F. and L.F. valves, as by doing so you could ensure that they will be operated within the makers' specified rating.

To obtain a sufficiently accurate idea of the actual voltages likely to be applied, you must first estimate the total current consumption of the set. The output valve takes 12 milliamps, while another 3 milliamps each may be allowed for the H.F. amplifier and for the detector; screening grid current can be ignored. This gives a total of 18 milliamps, and, by referring to the published regulation curve of the eliminator (reproduced in Fig. 1), we see that, for this current load, voltage will rise to slightly over 180 volts; therefore there will be a surplus of 30 volts.

The correct value for the voltage-absorbing resistance can now be ascertained by dividing "volts to be absorbed" by "current to be passed" (expressed as a fraction of an ampere). As the current to be passed through the resistance will be that for feeding the H.F. and output valves, it will amount to $12+3=15$ milliamps, so we get $30 \div 0.015$, or 2,000, which is the ohmic value of the necessary resistance.

It should be observed that in these calculations we have not fully taken into account the voltage drop in the common resistance of the rectifier and smoothing circuit due to the passage of current for the detector, screening grid, and potentiometer, but to do so is really quite unnecessary.

oooo

Making Decoupling Resistances.

Will you please give me some hints as to how to make a 600-ohm resistance for use in decoupling H.F. circuits?

M. L.

The exact form of construction is not a matter of great importance, provided that the finished resistance is substantially non-inductive, and has a reasonably low self-capacity. It is convenient to use six yards of No. 45 D.S.C. Ureka wire, which may be wound in two side-by-side grooves cut in a piece of ebonite rod of about $\frac{3}{4}$in. diameter. The grooves may be about $\frac{1}{32}$in. wide, and of the same depth; they should be as close together as possible—say $\frac{1}{32}$in. spacing between them. One-half of the wire should be wound in the first groove, and the remainder in the opposite direction in the other.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

Signal Frequency H.F. Stage.

I should like to add an aperiodic H.F. stage to my "Superheterodyne Adaptor" (as described in "The Wireless World" of April 23rd). My object is not so much to get amplification as to prevent re-radiation of oscillations generated by the unit.

J. O'D.

A H.F. amplifying valve with aperiodic choke input from the aerial may be connected as shown in Fig. 2, and should meet your requirements satisfactorily. No alteration will be necessary as far as the adaptor itself is concerned, except that the aerial lead-in connection, which will now be joined to the amplifier output, must be transferred from a tapping point on the tuned grid coil to the high-potential end of this circuit.

The aerial series condenser (C) may have a maximum capacity of 0.0001 mfd. or less.

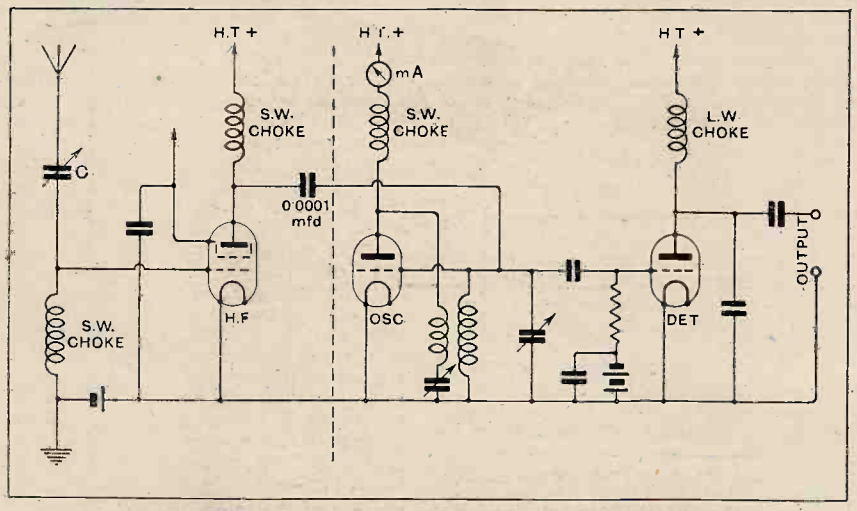


Fig. 2.—An aperiodic H.F. stage for the "Superheterodyne Short-wave Adaptor." Extra apparatus is shown on the left-hand side of the dotted line.

o o o o

A "Decoupling" Coupling.

From articles that have appeared in "The Wireless World" I gather that the resistance-fed transformer method of L.F. inter-valve coupling has the advantage that it confers a measure of immunity from undesirable inter-stage reaction, and that the usual decoupling resistance and condenser may not always be necessary when this system is employed.

In the case of a set with a detector followed by a single parallel-feed L.F. stage, would it not improve matters in this respect if a large condenser were connected between the detector anode and earth?

N. M.

Up to a point, it is true to say that interaction troubles are less likely to become evident when the parallel feed system is adopted than when a conventional transformer coupling is used; this is because a certain proportion of the signal-frequency of the L.F. energy in the detector anode circuit is deflected through the feed resistance, and does not give rise to voltages across any common resistance or impedances that may exist in the H.T. battery or eliminator circuits. Although the transformer windings through which speech-frequency currents are deflected have a greater impedance than that of the deflecting resistance at high frequency, the position is reversed with regard to very low frequencies, which generally give trouble of the kind we are trying to avoid. It must not be assumed, however, that the need for decoupling is always entirely obviated by using the parallel-feed system.

With regard to your suggestion of fitting an extra by-pass condenser, we think you have overlooked the fact that this would be effectively in parallel with the anode deflecting resistance, and also with the transformer primary; if it were large enough to serve any useful purpose it would act almost as a complete short circuit to the detector-L.F. output, and in any case it would adversely modify the characteristics of the L.F. amplifier.

o o o o

Apprehension in the North.

My home is quite near to the new Northern Regional Station, which, I understand, is likely to begin working in a few months' time. I am wondering whether the selectivity of my four-valve Pye receiver—one of the original Type 406 models—will be adequate for the new conditions, and it is therefore proposed to try an extra tuned aerial circuit, if you think that it can be added satisfactorily.

Which form of aerial coupling would you recommend, bearing in mind that I do not wish to alter my receiver internally? I have a copy of your issue for November 6th, 1929, in which additions of this sort were described.

B. G. R.

We see from the map that you live at a distance of nearly 20 miles from Slaithwaite, and so we do not think that interference will be particularly troublesome. However, no harm will be done by adding a loosely coupled aerial circuit, and to do so no internal alterations whatsoever need be made.

As your receiver embodies double-wound aperiodic aerial-grid transformers, we consider that the best method of making this addition is to use variable capacity coupling, and the arrangements shown in Fig. 2 of the article to which you refer would be highly suitable. The coupling condenser will, of course, be joined to the existing "aperiodic" aerial winding through the aerial terminal, and not to the high-potential end of the grid coil as shown in the diagram.

It would perhaps be as well to mount the extra apparatus in a metal screening box, thus avoiding all possibility of interaction between the aerial coil and the tuned intervalve coupling.

o o o o

Over-brilliant Reproduction.

I find that the reproduction of gramophone records through my receiver is too highly pitched, due, apparently, to over-emphasis of the upper register. Do you think that it would be worth my while to obtain a variable condenser to connect across the pick-up as a shunt, with a view to controlling tone? I do not think that the set is to be blamed.

C. L.

We do not know whether the over-accentuation of high notes of which you complain is due to a mechanical or an electrical resonance in the pick-up, but in either case we doubt very much if a capacity control would be satisfactory. In all probability a variable resistance, across the pick-up, would give better results.

FOREIGN BROADCAST GUIDE.

HAMBURG

(Germany).

Geographical position: 53° 30′ N., 10° 0′ E.

Approximate air line from London 449 miles.

Wavelength: 372 m. Frequency: 806 kc. Power: 1.7 kW.

Time: Central European (one hour in advance of G.M.T.).

Relays: Flensburg, 219 m. (1,370 kc.), 0.6 kW.; Bremen, 316 m. (950 kc.), 0.3 kW.; Kiel, 232.2 m. (1,282 kc.), 0.3 kW.

Standard Daily Transmissions.

G.M.T. 04.45, time signal; 05.25 weather, gramophone records; 06.00 concert, relayed from Liner in Hamburg harbour (Sunday); carillon; 11.00 concert; 12.05, concert; 19.00 main evening entertainment; dancing lesson (Sunday); news and dance music or relay of restaurant orchestra.

Man and woman announcers. Opening and interval signal: H A in morse (.... .—) and/or metronome. Call: *Achtung! Hier die Noragsender Hamburg, Bremen, Kiel und Flensburg.* Abbreviated between items to: *Hier Hamburg* (or whichever station provides the broadcast).

Closes down with "Gute Nacht," followed by Deutschland ueber Alles (Haydn's hymn: Austria).

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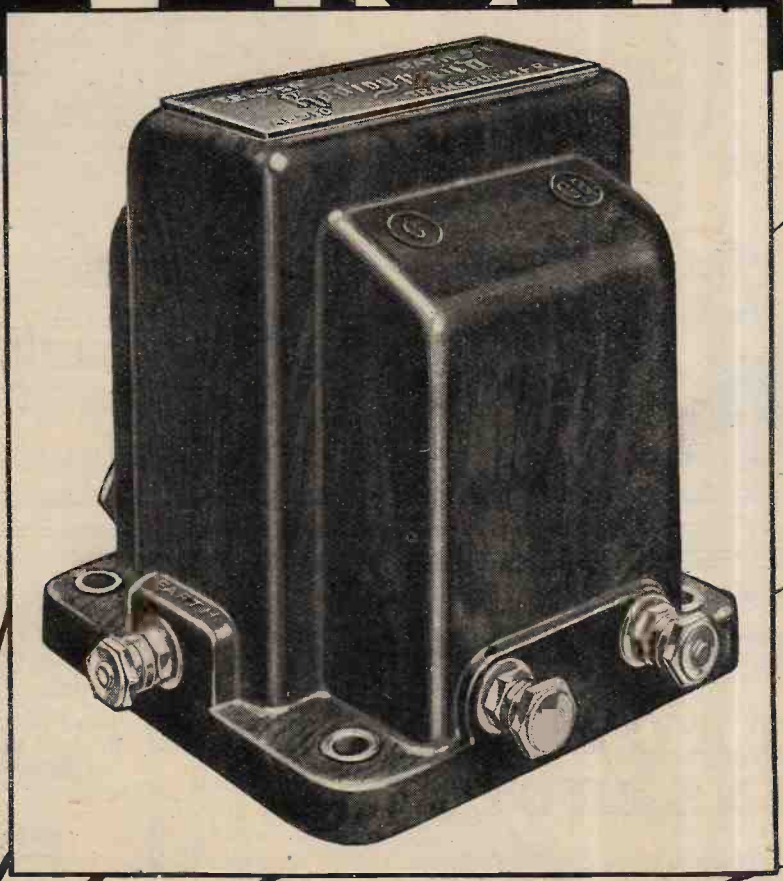

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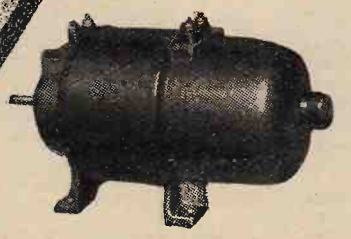
YOU can operate an A.C. all-electric receiver from D.C. Mains, Private House Plant or L.T. Accumulator by means of an

M-L

D. C. to A. C.
ROTARY TRANSFORMER

Contractors to The Air Ministry, The B.B.C., The G.P.O. Marconiphone, The Gramophone Co. Ltd., etc., etc.

Send for "The Book of the M-L Rotary Transformer" which gives full details.



The M-L MAGNETO SYND. LTD
Radio Dept. B, COVENTRY.
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NOW! the HEAYBERD Low Tension mains Transformer

Now it is possible to dispense with L.T. Accumulators by fitting a receiver with indirectly heated A.C. valves, the valves being operated by the Heayberd L.T. mains transformer which reduces the mains voltage to exactly 4 volts. This method of valve heating not only dispenses with unsightly accumulators but also effects a great saving in running costs. Prices from 9/- according to output voltage required. The combined transformer and choke designed for the saving of space in eliminators as well as for greater efficiency. Prices from 26/6 according to voltage and periodicity of mains.

The new combined component

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10, Finsbury Street, E.C.
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 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

Receivers for Sale.—Contd.

SIMMONDS BROS. are Specialising on "Wireless World" Four and Other Modern Receivers; superb workmanship guaranteed; exchanges.—38, Rabone Lane, Smethwick. [2155

YOUR Old Receiver or Component Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St, Preston. [0226

6-VALVE Receiver, single dial tuning, complete with Mullard valves, £6; twin linen diaphragm loudspeaker chassis, 22in.×22in., Blue Spot unit, factory made, £2; Igranic-Pacent gramophone motor, complete with turntable, 110-volt 60 cycles A.C., £2/5.—1, The Spur, Burnham, Bucks. [2346

MULLARD Orgola Four, A.C.240, complete, Regentone eliminator for above, Marconi moving coil speaker in mahogany cabinet, latest model, for 240 A.C.; all at £20.—68, Tottenhall Rd., Palmers Green, N.13. [2342

RADIO Corporation of America 7-valve 110 D.C. All Mains Set, with very good moving coil speaker, whole set in large handsome cabinet, spare set of valves, splendid long range instrument, little used; inspection invited; a bargain at £30, or nearest offer.—Bousfield, 2a, The Avenue, Upper Norwood, S.E.19. [2341

GREBE Short Wave Receiver, complete with 2 valves, 5 coils, etc., nearly new, excellent reception from 10 to 200 metres, 1 Amplion loud-speaker, type A.R.23, mahogany flare, 1 Wireless Equipment Co.'s transmitter for local reception, less batteries; what offers for each or the lot?—H. O. N. Shaw, 114, Wardour St., W.1. [2340

MARCONI Superhet. Model 82, complete, good condition, numerous accessories, including mains unit, accumulators, 2 speakers; sacrifice, what offers? —Full particulars from Captain X, c/o F. T. Harris and Co., Bude. [2338

MUSIC Magnet Four Kit, complete 2v. valves; £9/15.—H. Brown, 18, Kingshall Rd., Beckenham, Kent. [2337

EVERYMAN Four, new condition; £7; heard any time.—8, Fursby Av., Church End, Finchley, N.3. [2335

1930 Everyman Four, either H.F. portion only or complete receiver.—Baines, Handsworth Wood Rd., Birmingham. [2324

PHILIPS 3-valve Mains Receiver, 225v., perfect; bargain, £16.—Doone Cottage, Merstham, Surrey. [2322

END of Year Clearing.—The following slightly used material is offered subject to sale; every item will be severely tested before despatch and guaranteed in workable condition; prices quoted for receivers include set of tested valves to suit; in the case of portable receivers batteries are included.

McMICHAEL Screened Dimic Three, 3 only at 10 guineas each; Bowyer-Lowe 2-valve S.W. receiver, with coils, 10 to 2,000 metres, det. and pentode, 150/-; G.E.C. 3-valve S.W. receiver, with coils, 10 to 600 metres, det. and 2 L.F., 125/-; G.E.C. World Wide Four, 2 S.G., det., power, with 2 frame aerials, 250-2,000 metres, 340/-; another, ditto, ditto, 250/-; another, ditto, ditto, 180/-; G.E.C. Screened Three, 163/-; another, ditto, 155/-; G.E.C. 8-valve superhet., frame aerial, 250-2,000 metres, 250/-; another, ditto, ditto, 215/-; Truphonic 5-valve portable Melo-Set, 170/-; Selector 4-valve S.G. portable De Luxe, 290/-; Halcyon 4-valve S.G. portable De Luxe, 295/-; another, ditto, ditto, 265/-; Baird television kit, complete, 207/6; M.L. motor generator outfit, input 240 volts D.C., output 400 volts 100 m.a. and 6 volts 5 amps., complete with output smoothing equipment and cut-out, 345/-; another, ditto, ditto, 290/-.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0340

GENERAL Radio 3-valve, with valves and speaker; £3; guaranteed.—Electrocet Radio Co., Solihull, Birmingham. [2314

SEVERAL 3-valve Sets, oak cabinets, all wavelengths, new; 38/-; money back guarantee.—Wisson, 2, Cheapside, Deans Lane, Edgware. [2315

AMPLIFIER, cinema type, complete with moving coil speakers, valves, D.C. rotary converter, 12-volt input, 400-volt output, bargain, £30; Marconi moving coil speaker, 6-volt field, £2; Epoch super cinema moving coil speakers, cost £14/10, bargain, £7/10, as brand new.

VALVES, Leo Lion, cost £5, bargain, £2, as new; L.S.5a, 10/- each; B.T.H., B.4s, 4/- each; P.M.5x, P.M.5b, P.M.6, 5/- each; super power Six Sixty, 6/- each; all O.K. Triotron unit and chassis, new, 16/-; Mazda 625a, 7/- each; Cossor screen grid, 2-volt, 7/6; Osram, 2-volt, 4/-.—C. R. Jeffery, 25a, Strathville Rd., Southfields, S.W.18. [2375

3-VALVE All Mains (240-200 volts A.C.) 2-station Receiver and Gramophone Amplifier, 3rd prize Manchester Exhibition set building competition, superb reproduction, and best quality components alone worth price, complete with valves; £12/10.—Box 8265, c/o *The Wireless World*. [2368

Are You on A.C. Mains?

If so, use a BAKER'S SUPER POWER A.C. Speaker.

Every "Wireless World" reader who is on A.C. Mains should possess this superb Speaker.

This model comprises the finest A.C. equipment available to-day, including the famous Westinghouse H.T. l. Rectifier giving an output of 200 volts, 100 m.a.

A speaker which reveals magnificent efficiency and complete freedom from objectionable hum. The high quality of reproduction yielded by this Speaker lifts it high above all its competitors.

It has no equal!

Take a postcard NOW

and write for new and enlarged 32-page booklet on "How to get Realistic Reproduction"

IT IS FREE

and yours for the asking.

BAKER'S 'Selhurst' RADIO

Offices:
89 SELHURST ROAD, S. NORWOOD, S.E.25.

Works and Demonstration Room:
42 CHERRY ORCHARD ROAD, E. CROYDON

Receivers for Sale.—Contd.

3-VALVE Receiver, mahogany cabinet, 2 speakers, Exide L.T., 220v. A.C. eliminator; £6.—Bryant, 2, South Ridgway Place, Wimbledon. [2363

1931 Mullard Orgola, 2 S.G., det., Power A.C. valves, £13; Regentone eliminator, 240v. A.C. output 160v. 30 m.a., L.T. 4v. 4a., 95/-; Marconiphone m.c. speaker, mahogany, 240v. A.C. Westinghouse rectifier, Varley transformer, £8/10.—2, Melbourne Parade, N.13. [2362

FERRANTI Screened Grid Three, Blue Spot speaker, Mullard valves, 2 Exide accumulators, and £5/15 Ecko A.C. H.T. eliminator, contained in handsome solid oak cabinet, all principal stations; £17.—Apply Daniel, 14, Sunny Hill, Hendon. [2361

FAMOUS 5-valve Grebe Syncrophase, wonderful reception on aerial or frame, complete with valves; sacrifice, £9.—Mack, 58, Thornton Av., Streatham Hill, S.W.2. 'Phone: Streatham 2454. [2359

"WIRELESS World" Four, Foreign Listener's Four, or any other "Wireless World" circuit built to specification with listed components by experienced staff, work and results guaranteed.—Matlock Radio Manufacturers, Matlock House, Woodberry Grove, Finchley, N.12. 'Phone: Finchley 2837. [2358

MULLARD Orgola Senior Kit, unused, list approximately £15, sell £8; Lissenola speaker, new 22/6, sell 10/-; 2 Mazda P.240, new 13/6, sell 6/6 each Newth, 31, George St., Hanover Sq., London, W.1. [2357

SCREENED Grid 3-valve Selective, good quality, professionally built; £12/15.

"WIRELESS World" Kilo Mag. 4, unused, professionally built; £15.

R.S.G.B. Screened Grid, short wave receiver, in aluminium case, professionally built; £18.

M-L Converter, 12v.-500v, 120 m.a., new, perfect, smoother and starter, in steel box; cost £20/10, for £15/10.

NEW Osram Music Magnet Four Kit, unopened (first cash secures); £9/15.—Apply Mark, 10, Canongate Rd., St. Andrews. [2352

ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators, by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0623 (3 lines). [1466

CHARGERS AND ELIMINATORS.

PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5. 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5. 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 495, Cambridge Rd., London, E.2.

CHESTER BROS.—Type V3 220+220v., 35 m.a., 5v. 1.6a., C.T., 4v. 4a. C.T., 27/6.

CHESTER BROS.—Type W.10, for H.T., 3 or 4, output 135v. 50 m.a., and 4v. 4a., C.T.; 23/6.

CHESTER BROS.—Smoothing chokes, constant inductance, type C.B.2, 45 henrys, 25 m.a.; 15/-.

CHESTER BROS.—Write for lists of standard models. Please note change of address. [1477

H.T. Eliminator Kit, incorporating Westinghouse H.T.5 rectifier, kits consist of transformer, choke, Westinghouse rectifier; required condensers, resistance, safety plugs and sockets, and baseboard; output 20 milliamps at 120 volts, 47/6, post free; metal case for same, 3/9 extra.

ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

VORTEXION Transformers and Chokes, wound to specification; best quality components only supplied.

VORTEXION No. 4 Bobbins, 1in.×1½in., 1/3, post 2d.; 1in.×1in., 1/-, post 2d.; cast aluminium end plates, 2/3 per pair, post 2d.; No. 4 laminations for 1½in. bobbins, 6/2, post 9d.; for 1in. bobbins, 4/2, post 6d.

VORTEXION, 72, Merton Rd., Wimbledon, S.W.19. Tel.: Wimbledon 2814. [0439

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Each paragraph is charged separately and name and address must be counted.

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ADVERTISEMENTS for these columns are accepted up to **FIRST POST on THURSDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on **WEDNESDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

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The proprietors retain the right to refuse or withdraw advertisements at their discretion.

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All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box ooo, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. ooo, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

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IMPORTANT NOTICE.

Owing to the Christmas Holidays, the issue of **"THE WIRELESS WORLD"** for December 17th must be closed for press earlier than usual.

The **MISCELLANEOUS ADVERTISEMENTS** for insertion in that issue can be accepted up to **FIRST POST, WEDNESDAY, DECEMBER 10th.**

WITHOUT FEAR—
Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.
Particulars from the Secretary,
HONOR OMNIA SUPER **APPLEBY'S,**
Chapel St., Marylebone, London

NEW SETS for OLD!

Here is an excellent opportunity for you to exchange your existing RADIO SET or GRAMOPHONE for a new and up-to-date model. We will make a liberal allowance on your old instrument in part exchange for a new RADIO SET or GRAMOPHONE of any make which we will supply. We gladly offer you, *free*, our expert advice in the choice of a new instrument. Just write us giving particulars of your present radio set or gramophone, stating in what type of new instrument you are interested.

DRAZIN *Radio and Gramophone Specialists,*
59-59B, HEATH STREET, HAMPSTEAD, N W.3.
M.C.3. *Telephone: Hampstead* 8714.

B&J
"WIRELESS WORLD" FOUR.

Coils	9/6	each.
Coil Screens	3/-	each.
Valve Screens	2/9	each.
Bijou Binocular Chokes	4/-	each.

Approved by "The Wireless World."
B & J. Wireless Co.
ATHELSTANE MEWS, N.4.
Arc. 1695

18 to 70 METRES!
Electrocets Empire 2, SHORT WAVE RECEIVER
Astounding range, contained in an oak cabinet, strongly made and designed for export.
£4 : 5 : 0.
3 valve model £5.
Changeable coil for wavelengths between 200 and 2,000 metres 8/- extra.
This set can be sent C.O.D. to most countries. Postage and C.O.D. Extra.
Agents wanted, and trade inquiries invited. Sample sent C.O.D.
THE ELECTROCET RADIO CO.,
Poplar Road, Solihull, Birmingham.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors. — Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

PHILIPS 2515 Electric Receiver, 2-valve, 230 volts, £7; McMichael Super-range Portable Four, as new, £17; Marconi 55 Portable, as new, £12; Philips 2754 10 watt amplifier, all electric, 230 volts, £14.—Gregory, Cliff St., Cheddar. [2289

MARCONI Combined 2-valve Amplifier, field supply and mains rectifier for 200-volt A.C. mains; also Marconi moving coil speaker.—116, Court Lane, Dulwich. [2282

CROSSLEY 1929 Bandbox Radio, 6 valves, Mullard valves, pick-up adaptor; 12 guineas, or offer.—B.M./B.R.4E, London, W.C.1. [2271

FOR Sale, Celebritone cinema amplifier, 2-stage, 8-valve, complete with A.C. H.T. rectifier, output 650v. 150 m.a., Brown M.C. speaker, 2 trickle chargers (Celebritone), etc.; first £25 secures.—D.P., 51, Priesthills Rd., Hinckley, Leicestershire. [2270

ALL Wave Four, Jacobean oak cabinet (cost £5/10), G.E. Co., components with Bercliff coils, complete with valves, eliminator; bargain, £12.—J. H. J., 613, Scott Hall Rd., Chapel Allerton, Leeds. [2283

PHILIPS 4-valve A.C. Mains Receiver, 210v., Brown's permanent magnet speaker, 3-valve, short waver, Philips eliminator, battery charger, battery, voltmeter, Brown's headphones, lot cost over £80, in perfect condition; owner ordered abroad; price £30 the lot; heard in operation by appointment.—Tel.: Abercorn 3152. [2284

MEGAVOX Receiver (S.G.-det.-pent.), case, valves, accumulator, £8; Majestic A.C. eliminator, 200-240 volts, with spare valve, £4/10; Mullard filament transformer, 210 volts, £1; P.M.164v, 10/-.—Cave, 133, Downton Av., Streatham Hill, S.W.2. [2288

BIG Demand, modern 3-valve receivers, 70/-; cabinet speakers, 20/-; ready switch on.—Simmons Wholesale Radio, 9, Ilfracombe Av., Southend-on-Sea. [2294

McMICHAEL All Mains 3-valve; cost £21, accept £18.—After 7, 46, Colin Park Rd., Colindale. [2303

GRAMO-RADIO Combined, 5-valve set, S.G. push-pull, perfect, magnificent instrument; £9.—5, Vallance Rd., N.22. [2313

PART Exchange.

PREMIER.—Part exchange; every radio set in stock; Columbia, Philips, K.B., Ecko, Pye, G.E.C., Cossor, Mullard, Lotus, Ediswan, Lissen, Marconi, McMichael, R.I., Selector, Dubilier, Ultra, Rolls, Caydon, Amplion, Burndept, Dunham, Ormond, H.M.V. and Columbia gramophones and radiogramophones; cash or H.P.

DON'T be Satisfied with an Obsolete Set, exchange it with us for a really modern set or kit.

EXCHANGE Your Music Magnet Three for the New Osram Four.

MAINS Equipment of Every Kind on Deferred Terms to Suit Your Pocket.

GENEROUS Allowance on Your Old Set, balance cash or H.P.

OUR Experience is at Your Disposal, free, of course; no annoying restrictions.

DEMONSTRATIONS with Pleasure; only brand new goods supplied.

RADIOGRAMOPHONE Cabinets, from 59/6 to £8.

PEDESTAL Radio Cabinets, to take 18×7 panel, and all batteries and loud-speakers; 29/6.

AS an Example.—We can supply you with an Ecko all mains 3-valve set for 5/- a week, and take your old set or components in part payment.

PREMIER SUPPLY STORES, 20-2, High St., Clapham, S.W.4. 'Phone: Battersea 5154.

HOURS of Business, 9-8, Saturdays 9-9 p.m., Wednesdays, 9-1 p.m. [2379

SLIGHTLY Soiled Sets Sale.—Portables are new, carrying maker's guarantee; deposit system if desired.—Frost.

ORMOND Transportable Five, turntable, waterproof cover, stations logged on chart; complete, £10.

DUNHAM Oak Upright Five, £18/10 model, Mullard valves, Jellacid accumulator, turntable, Hellensen H.T. great range, volume, make splendid gift; £11.

HARMONY Super V Suitcase, very compact (suit lady), delightful tone; absolutely complete, £6/10.

SILVERTONE Screened Five Suitcase, very selective, a treat to handle, expensive production, best accessories; £10.

GENERAL RADIO 2-valver, self-contained, good order, condition, including valves and internal speaker; 35/-.

S.G.3 Table Set, doors enclose batteries, very powerful, immense range, Mullard valves, best components, excellent present; £4/10.

ABOVE Sets Seen, heard, bought at Frost's Radio, 132, St. John's St., E.C.1. [2378

LOTUS ALL MAINS UNIT

FOR ALTERNATING CURRENT ONLY

The Lotus All Mains Unit has a very generous power output and is most suitable for 4-valve sets; it may also be used as H.T. Eliminator for sets having battery heated valves. The whole apparatus is contained in a handsome metal case 12" × 8" × 8" high. Price complete **£7 7s.**, or 12 monthly payments of **13/3.**

From all Radio Dealers.

Write for illustrated Catalogue to
GARNETT, WHITELEY & CO., LTD., LIVERPOOL.

SNICK !

Think of the convenience of being able to make all the circuit changes possible to a Double-Pole Change-over switch merely by giving a half-twist to the bakelite pointer knob of this switch.
See the circuits in which it can be used in our 1931 Radio Catalogue free on request.

THE BENJAMIN ELECTRIC Ltd.,
Tariff Road, Tottenham, N.17
Tottenham 1500.

3/6

BENJAMIN

Chargers and Eliminators.—Contd.

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

FERRANTI B.E.N.I. Eliminator, 200 volts, 100 milliamps, as new; £9.—Pickering, Little Poulton, near Blackpool. [2292

SALE, eliminator, 50 milliamperes and 4 volts, £4; Marconi choke, 7/6; G.E.C. pick-up, 12/6; L.F. transformers, 5/-; L.F. chokes, 4/-; 3 short wave coils, 4/-; L.T. charger, 25/-; Blue Spot speaker, mahogany, 32/6; Climax Chello speaker, 27/6.—Capper, 20, Parkers Rd., Sheffield. [2285

OLDHAM Charger, type A.C.H.T./3, 200-250 volts, 50-60 cycle, complete with 4-pin plug connection, as new, unused; what offers?—Brewer, Headland Park Rd., Paignton. [2276

RADIELLE D.C.100 (200-250 D.C.), output 200 volts 100 m.a., 2 variable and 1 single grid tappings; cost £9/10, sell £3; brand new.—Priestley, 8, Grosvenor Gardens, Muswell Hill, London, N.10. [2318

WESTINGHOUSE Rectifiers.—Two output 200v. 40 m.a., 19/- each; one output 135v. 30 m.a., 10/-; Hydra 1,000v. 6 mfd., 8/-; S4V, 11/6; A.C.P.1, 8/6.—55, Teddington Park Rd., Teddington, Middlesex. [2327

BRYCE'S.—Mains transformers make ideal Christmas presents. Order the favourite now. Type A.B.64, as supplied to manufacturers; output 250-0-250v., 60 m.a., 4v., 1a., C.T., 4v., 3a., C.T., 6v. 1a. C.T.; price 24/6, post 1/-; fully guaranteed; write for lists, they are valuable.—Bryce's, 54, Dawson St., Bury, Lancs. [2330

25- and 50-Cycle Mains Apparatus; transformers, chokes, and complete eliminators in production, variety of outputs available; hum free guaranteed products, suitable for driving M.C. speakers; lists free of stock types; special designs to order up to 500 volts output. Rectifiers, electrolytic condensers, smoothing condensers, G.B. resistances, or any parts supplied separately; trade enquiries invited.—Postlethwaite Bros., Kinver, Stourbridge. [2339

EKCO All-Power Unit, model C2A, for A.C. mains; L.T. 2-6 volts, H.T. S.G.60, 120-150 volts, G.B. 1.5-12 volts, perfect condition; £5/10.—Box 8271, c/o *The Wireless World.* [2371

SOUND SALES.—Genuine Stalley Stampings.

NO. 30 for "Wireless World" choke, 1½in. core, 4/6, post free; 1in. core, 3/6, post free.

NO. 4 Stalloy Stampings, 1½in. core, 6/-, post free: 1in. core, 4/2.

CLAMPS and Bolts for Above, 1/6 and 2/-.

WE Can Supply Any Wire, bobbin, terminal strips, etc., c.o.d.

"WIRELESS World" Constant Inductance Chokes; 15/-; repairs a speciality; see our speaker advertisement.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2364

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3; 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformers for the New Westinghouse Units; please write for list.

SAVAGE'S New Foreign Listeners' Four Equipment. —Transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/0, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains transformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone: Bishopsgate 4297. [1784

MAINS Transformers.—240×240 80 m.a., 4v. 5a., 4v. 2a., 25/-; with 14v. winding, 35/-; 135v. 50 m.a., 4v. 5a., 19/6; 250×250, 80 m.a., 4v. 5a., 5v. 1.6a., 25/-; any eliminator part supplied; special transformers made in 24 hours.—Challis, 22, Park Rd., Rugby. [2232

POWER CHOKES
guaranteed twelve months

Substantially built, for smoothing circuits in eliminators dealing with currents 100 to 300 milliamperes, inductance 30 henries,

8/6 Post Free. C.W.O

REPAIRS

Any make of L.F. Transformer, Loudspeaker (except Blue Spot) or Headphones repaired and despatched within **48 HOURS. TWELVE MONTHS' GUARANTEE** with each repair. **4/-** Post Free. *Cash with Order.*

Terms to Trade.

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As supplied to the Leading Telephone Apparatus Manufacturers. Flexible and Instrument Cords of all types. "Connectite" Wire.

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MOVING COIL SPEAKERS
Watch for announcement of
NEW PERMANENT MAGNET MODEL
12 UNION COURT, OLD BROAD ST., E.C.2.

BONA FIDE TRADERS' GUIDE.

Send for our comprehensive Illustrated List.
QUICK SERVICE. QUICK SERVICE.

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SCREENING BOXES

and metal cabinets, all sizes made to order, from best hard aluminium. Standard size screening boxes from stock.

6×6×6½ - - - price **4/-** each.
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Registered Trade Mark
Patent STEEL STORES System

For the Wireless Experimenter, Factory, Factor and Retailer.
Full Particulars from Sole Manufacturer and Patentee:—
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Learn how the

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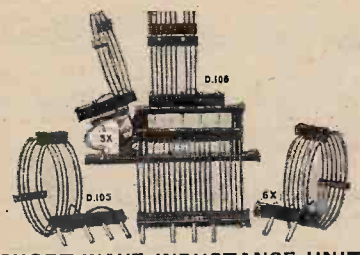
EDDYSTONE

SHORT WAVE APPARATUS

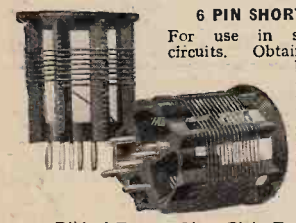


SHORT WAVE INDUCTANCE UNIT.

This unit forms the complete inductance portion for a short wave receiver, providing variable aperiodic aerial coil, grid coil and reaction winding. Complete with stand and 5 coils, it covers efficiently the whole short waveband from 15-95 metres.

Price 22/6 complete with full circuit details.

(Extra coils for B.B.C. waveband can be obtained)



6 PIN SHORT WAVE COILS.

For use in screened-grid S.W. circuits. Obtainable for all wave-bands from 12·5 to 2,000 metres. Air wound on a skeleton bakelite former. Special banana type pins ensure perfect contact.

Price 4/6 to 5/6 per coil.

Ribbed Former 3/- Plain Former only 2/6.

Send for list No. 25 of short wave apparatus.

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THE QUALITY INSTRUMENT.

Then you will be sure of consistently good reception, for you will always know exactly what voltage and current your batteries are giving.

A Sifameter measures 0-15 volts for L.T. & G.B. 0-150 volts for H.T. 0-50 milliamps for plate current. An indispensable aid to better radio. Of all radio dealers. New literature sent on request.

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'Phone—Temple Bar 3871.

CABINETS.

ARTCRAFT Cabinets, illustrated list free; radio-grams, from 79/6; unbeatable value.—Artcraft Works, Grant Rd., Croydon. Established 1925. 'Phone: 1981. [1814

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.

DIGBY'S Cabinets, fitted with Radion or Resiston ebonite if required.

DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.

DIGBY'S Cabinets Made to Customer's Own Designs.

DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [1479

KAY'S Cabinets.—Exclusive practical models in radio and radiogram cabinets, 50% cheaper than elsewhere, used and recommended by the most distinguished and discriminating radio experts; a range of 60 designs to select from; illustrated price lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Waltbamstow 1626. [1789

ACTUAL Manufacturer Wishes to Dispose of 50 Walnut Radio-Gram. Cabinets, size 42in. high, 21in. deep, 2ft. wide; front panel will take set up to 21in.× 7in., speaker fret artistically designed, front enclosed by 2 doors, cabinet veneered with best figured walnut, hand French polished, highly finished.

WITH Each Cabinet Given Written Guarantee, actual cabinets on view; if requested design can be sent; price £6/6 each; special discounts given for quantities; trade enquiries invited; any design cabinet made to own requirements.—L. Marcus, 77 East Rd., N.1. Clerkenwell 8341. [2323

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

COILS.—Band Pass Three and Four, Regional One, etc.; write for quotation.—R. Thurley, 108, Fore St., Edmonton, N.18. [2206

BAND Pass Three Coils, 30/- set, "Wireless World" specification; slotted formers for winding, 8/6 set; grooved primary supports, 2/- set; All D.C. Three formers, 8/- set; decoupling resistances, 1/6 each; all post free.—Groves Brothers, Coil Manufacturers, St. Mary's Place, Shrewsbury. [2269

BAND Pass Three Set of Coils, 31/6; Band Pass superheterodyne, set of 5 coils on ebonite, with mounts, 33/-; post free.—Woodfall, 1, Clark's Buildings, High St., London, W.C.2. [2360

LEWCOS D.B.A. and D.B.G. Binocular Coils; 15/- pair.—Deadman, 6, Abingdon Rd., Kensington, W.8. [2356

COILS.—Band Pass superheterodyne, complete set, 30/-; Band Pass Four, 25/-; Band Pass Three 35/-; "Wireless World" Four, with screens, switches, 52/-; c.o.d.—Smith 3, Park Parade, Harlesden, N.W.10. [2344

APPLEBY Coils for "Wireless World" Four, with switches, 36/- set of four, post free; screen for above coils, 3/3 each, post free.

APPLEBY Screen Tubes for Screened Grid Valves, ventilated and insulated at cap aperture; 2/9 each, post free; suitable for "Wireless World" Four and all modern circuits.

APPLEBY Midget Binocular, iron cored H.F. chokes suitable for "Wireless World" Four and all modern circuits; 3/9 each, post free.

APPLEBY Standard High Inductance H.F. Choke for All-purpose Use where high inductance and low coil capacity are essential; 6/6 each, post free.

APPLEBY 600 and 700 ohms. Midget Resistances for All Decoupling Purposes; 1/6 each, post free.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0343

BERCLIF Coils, the finest made, for all receivers; get our list (post free) before buying; trade supplied.—Simmonds Bros., 38, Rathbone Lane, Smethwick. [2156

GRAMOPHONES, PICK-UPS, ETC.

BLUE Spot Pick-up, 25/-; valves: P.M.6D, P.M.6 4/6 each, L.S.5 7/6, as new.—Harvey, Queen St., West Bromwich. [2306

MARCONI Pick-up, unused, guaranteed absolutely perfect; 42/-.—Smith, 10, Parade, Felixstowe. [2304

TWO Marconi Pick-ups, as brand new; £2 each.—Gilbert, 54, Hazelbourne Rd., London, S.W.12. [2381

MARCONI Pick-up, new, used test only; £2; approval against cash. 6, Weymouth Drive, Glasgow, W.2. [2377

The Greatest "Buy" in Speakerdom!

EPOCH

New Model A1 Permanent Magnet Moving Coil Speaker.

Cobalt Steel.

A Genuine Moving Coil Speaker at the price of an imitation, or of an iron movement.

No Mains
No Batteries
Real Reproduction

Comprising:

Real Treble
Real Bass
Real Speech

and it's a

Real Bargain at

£3-7-6

Complete, ready to put in a cabinet or on a baffle board (Cabinet Models from £5.5.0).

What a Present for Xmas!

(Guaranteed delivery of a limited number if ordered at once.)

Write for the new Booklet WS4a, containing the finest information on Moving Coil Speakers, both permanent and energised—it's free.

Epoch Radio Manufacturing Co., Ltd., Farringdon Avenue, E.C.

Gramophones, Pick-ups, etc.—Contd.

B.T.H. Gramophone Motor, unused, £2; Burndept pick-up, 7/6.—Box 8269, c/o *The Wireless World.* [2369

GRAMOPHONE Motor, Swiss made, universal voltage, A.C. or D.C. auto stop, never used, cost £5/10; also B.T.H pick-up and arm; £4/10 the lot. —Neal, 326, Pinner Rd., North Harrow. [2326

VALVES.

AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required).

FILAMENT Volts 6, plate volts 400 (maximum), grid bias 84 volts (approx.), impedance 800 ohms, amplification factor 3.8, mutual conductance 4.35 m.a./volts; price now reduced to £5; see article "The Wireless World," 24th July, 1929, then send to North London Valve Co., Ltd., 22½, Cazenove Rd., Stoke Newington, London, N.16. [0341

ONE Each of H.610, L.610, P.625A, used, L.S.5, L.S.5A, new; 45/-.—314, Friern Rd., S.E.22. [2307

XMITER Has for Sale 2 D.E.T.I. Valves (unused), 500 volts, 130 m.a. Eaco generator, 6v. input.—Box 8256, c/o *The Wireless World.* [2310

FIVE L.S.5As and 3 U8s, little used; what offers? —116, Court Lane, Dulwich, S.E.21. [2281

P.M.16, as new, 10/-; P.M.5B, 3/-; B4, 3/-; three 6v. 0.1, 2/6 each; perfect; lot 20/-; also Exide 6v. 40 amps. actual, 15/-; components, stamp for list. Wanted. Blue Spot and chassis.—57, Admiral St., Liverpool. [2351

FERRANTI A.F.5, 19/-; A.F.5C, 24/-. Valves: two Mazda P625B, 9/6 each; Marconi L610, 6/-; P.M.6D, 6/-.—Snelgrove, Rosemouth, Hursley Hill, Whitchurch, Somerset. [2336

LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition; see displayed advertisement on page 19. [0231

B.T.H. Senior R.K. Moving Coil Unit, 10in. diaphragm, £4/15; Marconi model 75, 30/-.—Gregory, Cliff St., Cheddar. [2290

BARGAINS!—Few only, Grassman moving coil speakers, new, 220 volts, D.C.; also 6 volts 1 amp. and 220 volts 45 milliamps, £2; in oak cabinet, £3.—C. and N. Booth, 139, Middlewood Rd., Sheffield. [2311

REALISTIC Speakers, wood diaphragm, ingenious construction, unrivalled results, true to its name; chassis, 27/6, fit any unit; complete speakers, £3/10 to £25; write for particulars, demonstrations daily.—Realistic Speakers, 72, Penton St., London, N.1. [2308

FERRANTI A.C. Moving Coil Speaker Chassis, £11/15 model, perfect condition, suit 240v. 50 cycles; £6.—Box 8254, c/o *The Wireless World.* [2302

LATEST Celestion Z20, cost £7/15, practically new, makers' guarantee, beautiful instrument; £3/10. —3, Silverton Rd., Coventry. [2299

EPOCH Moving Coil Speaker, model 66, Ferranti transformer for pentode output, Philips low tension unit for 220v. A.C., complete; £5.—41, Little Heath, S.E.7. [2286

BAKER'S 1930 Permanent Magnet M.C. Speaker, £3/5; 1931 model, £4; Magnavox, 6-volt type, £2/10.—Maddock, 71, Sprules Rd., Brockley, S.E. [2272

PERMANENT Magnet Moving Coil by Sherwood, Hatton Garden, London, brilliant performance, reviewed W.W. 15th January, new, perfect; 3 guineas; particulars.—Box 8270, c.o *The Wireless World.* [2370

MARCONIPHONE 6-volt M.C. Speaker, chassis, with transformer, £3; Mullard S.V.12, 10/-; Pentone 22, 10/-; P.M. 4DX, 4/6; very little used.—BM/CREM, W.C.1. [2355

AMPLION Loud-speaker, mahogany built, in amplifier, A.C.; cost £48, accept £20; seen by appointment.—Lansdown, The Green, Sidcup, Kent. [2332

SOUND SALES Specialise in Moving Coil Speaker Repairs.

SOUND SALES Supply Replacement Mains Transformers from 15/-.

SOUND SALES Convert D.C. and Battery-excited Speakers to A.C.

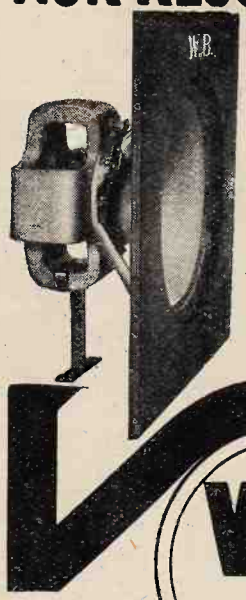
SOUND SALES Give the Highest Price for Your Speaker in Part Exchange any New Moving Coil Instrument.

SOUND SALES' Prices Secure Your Custom.

SOUND SALES' Service Retains It.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2365

NEITHER BOOM NOR RESONANCE



Mr. Barton Chapple has 'nothing but praise' for the new W.B. Permanent Magnet Moving Coil Speaker. "A nice crisp note is revealed," he says, "while a very even balance is maintained throughout the musical scale—nothing boomy, nothing shrill." Hear this new speaker yourself—your dealer will demonstrate.

Available in chassis form with 14 in. baffle, £6 . 6 : 0
Oak Cabinet Model, £8 : 8 : 0
Mahogany £8 : 18 : 6
Walnut £9 : 9 : 0

W B

Made by the Makers of the Famous W.B. Cone Speakers, Switches and Valve Holders.

Whiteley Electrical Radio Co., Ltd., Radio Works, Nottingham Road, Mansfield, Notts.

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Look for the CLIX SHOWCASE on Your Dealer's Counter.

You will easily recognise its artistic three-colour cover. It contains a popular assortment of CLIX Fitments. Contents clearly displayed and priced.

No. 1 Prov. Pat.
COIL PIN, 2d.

One of the 14 Clix lines included in the Showcase. There are 27 different Clix devices for contact. Write for descriptive leaflets.

LECTRO LINX, LTD.
254 VAUXHALL BRIDGE ROAD, S.W.1.

Loud-Speakers.—Contd.

EPOCH Moving Coil Speakers.

EPOCH.—Everybody who heard the Model 99 agreed with the "Sunday Observer" that it was the finest Speaker in Olympia.

EPOCH.

EPOCH.—Everybody who heard—who didn't?—agreed with the London "Evening News" that the Super Cinema Model was truly named.

EPOCH.

EPOCH.—But those who managed to hear the new Model 101 (Domino) under fair working conditions will never forget it.

EPOCH.

EPOCH.—They will never rest until one of these Speakers is on their sets.

EPOCH.

EPOCH.—The new 101 (Domino).

EPOCH.—The new 101 (Domino).

EPOCH.—The new 101 (Domino).

EPOCH.—The new 101 (Domino).

EPOCH.—The greatest advance in the history of energised Moving Coil Speakers.

EPOCH.

EPOCH.—The new 101 cannot be adequately described.

EPOCH.

EPOCH.—All standards of quality reproduction must be revised.

EPOCH.

EPOCH.—Never before has such clarity been achieved.

EPOCH.

EPOCH.—Never before has such sensitivity and power been obtained in a Home model.

EPOCH Model 101.—The speaker of no comparison.

EPOCH.—Epoch Permanent Magnet Moving Coil Speakers; all models greatly improved.

EPOCH.

EPOCH.—First and foremost the Cabinet Models C12, C13, and C14, prices complete from £5/19/6.

EPOCH.—These contain very powerful permanent magnet Moving Coil Speakers.

EPOCH.—They are not just units fitted into cabinets, but are specially balanced as Cabinet Speakers.

EPOCH.

EPOCH.—No drumminess; no box resonance, but clear, sharp, marvellous reproduction.

EPOCH.

EPOCH.—Magnificent woodwork, very compact.

EPOCH.—They cost less than some makes of inferior units without Cabinets.

EPOCH.—Permanent Magnet Moving Coil Speaker Units for portables; £3/15; ready for use.

EPOCH.

EPOCH.—Standard Cross Magnet Permanent Magnet Speaker; price £4/4; the finest of its kind.

EPOCH.

EPOCH.—Permanent Magnet Super Speakers; they are £6/12/6.

EPOCH.—Remember, the famous 66 and 99 Speakers are heavily reduced in prices.

EPOCH.—The 99 is also further improved in sensitivity.

EPOCH Range of Moving Coil Speakers is the largest in the world; a Speaker for every requirement.

EPOCH.

EPOCH.—Send for booklet S4, the most interesting and useful publication on the subject.

EPOCH.

EPOCH.—Send for the 7 days' approval arrangements.

EPOCH.—Send for the H.P. terms.

EPOCH.—Call for a demonstration.

EPOCH RADIO MANUFACTURING Co., Ltd., Farringdon Av., E.C.4 (between Holborn and Ludgate Circus). 'Phone: Central 1971 (3 lines). [1628

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12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to **FIRST POST on THURSDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on **WEDNESDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box ooo, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. ooo, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

IMPORTANT NOTICE.

Owing to the Christmas Holidays, the issue of **"THE WIRELESS WORLD"** for December 17th must be closed for press earlier than usual.

The **MISCELLANEOUS ADVERTISEMENTS** for insertion in that issue can be accepted up to **FIRST POST, WEDNESDAY, DECEMBER 10th.**

WITHOUT FEAR—
Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.
Particulars from the Secretary,
HONOR OMNIA SUPER **APPLEBY'S,**
Chapel St., Marylebone, London

NEW SETS for OLD!

Here is an excellent opportunity for you to exchange your existing RADIO SET or GRAMOPHONE for a new and up-to-date model. We will make a liberal allowance on your old instrument in part exchange for a new RADIO SET or GRAMOPHONE of any make which we will supply. We gladly offer you, *free*, our expert advice in the choice of a new instrument. Just write us giving particulars of your present radio set or gramophone, stating in what type of new instrument you are interested.

DRAZIN *Radio and Gramophone Specialists,*
59-59B, HEATH STREET, HAMPSTEAD, N W.3.
M.C.3. *Telephone: Hampstead* 8714.

B&J
"WIRELESS WORLD" FOUR.

Coils	9/6	each.
Coil Screens	3/-	each.
Valve Screens	2/9	each.
Bijou Binocular Chokes	4/-	each.

Approved by "The Wireless World."
B & J. Wireless Co.
ATHELSTANE MEWS, N.4.
Arc. 1695

18 to 70 METRES!
Electrocets Empire 2, SHORT WAVE RECEIVER
Astounding range, contained in an oak cabinet, strongly made and designed for export.
£4 : 5 : 0.
3 valve model £5.
Changeable coil for wavelengths between 200 and 2,000 metres 8/- extra.
This set can be sent C.O.D. to most countries. Postage and C.O.D. Extra.
Agents wanted, and trade inquiries invited. Sample sent C.O.D.
THE ELECTROCET RADIO CO.,
Poplar Road, Solihull, Birmingham.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors. — Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

PHILIPS 2515 Electric Receiver, 2-valve, 230 volts, £7; McMichael Super-range Portable Four, as new, £17; Marconi 55 Portable, as new, £12; Philips 2754 10 watt amplifier, all electric, 230 volts, £14.—Gregory, Cliff St., Cheddar. [2289

MARCONI Combined 2-valve Amplifier, field supply and mains rectifier for 200-volt A.C. mains; also Marconi moving coil speaker.—116, Court Lane, Dulwich. [2282

CROSSLEY 1929 Bandbox Radio, 6 valves, Mullard valves, pick-up adaptor; 12 guineas, or offer.—B.M./B.R.4E, London, W.C.1. [2271

FOR Sale, Celebritone cinema amplifier, 2-stage, 8-valve, complete with A.C. H.T. rectifier, output 650v. 150 m.a., Brown M.C. speaker, 2 trickle chargers (Celebritone), etc.; first £25 secures.—D.P., 51, Priesthills Rd., Hinckley, Leicestershire. [2270

ALL Wave Four, Jacobean oak cabinet (cost £5/10), G.E. Co., components with Bercliff coils, complete with valves, eliminator; bargain, £12.—J. H. J., 613, Scott Hall Rd., Chapel Allerton, Leeds. [2283

PHILIPS 4-valve A.C. Mains Receiver, 210v., Brown's permanent magnet speaker, 3-valve, short waver, Philips eliminator, battery charger, battery, voltmeter, Brown's headphones, lot cost over £80, in perfect condition; owner ordered abroad; price £30 the lot; heard in operation by appointment.—Tel.: Abercorn 3152. [2284

MEGAVOX Receiver (S.G.-det.-pent.), case, valves, accumulator, £8; Majestic A.C. eliminator, 200-240 volts, with spare valve, £4/10; Mullard filament transformer, 210 volts, £1; P.M.164v, 10/-.—Cave, 133, Downton Av., Streatham Hill, S.W.2. [2288

BIG Demand, modern 3-valve receivers, 70/-; cabinet speakers, 20/-; ready switch on.—Simmons Wholesale Radio, 9, Ilfracombe Av., Southend-on-Sea. [2294

McMICHAEL All Mains 3-valve; cost £21, accept £18.—After 7, 46, Colin Park Rd., Colindale. [2303

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LEWCOS Coils, S.P.T., S.P.A. C.T.35. 60×200, 250, Lotus D.P.D.T. switch, Mullard 200,000, Varley 20,000, Igranic 0.5 resistances, Ormond 0.0003 S.M. condenser, all new condition; half list price.—16, Emanuel Av., W.3. [2317

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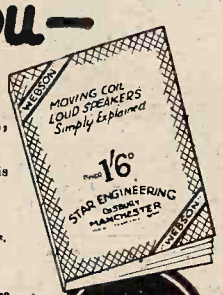

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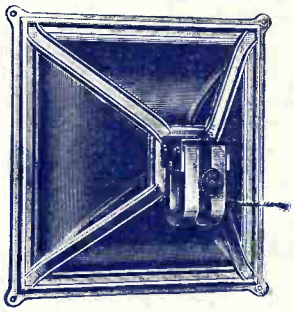

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Radio and Gramophone each placed at the correct height for ease of handling. Takes any commercial equipment. Ample room for all accessories and loudspeaker. This original design is registered. Supplied only in **Oak £5 : 19 : 6**

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This is the Gramo-Radio Cabinet chosen by a leading radio journal as their Olympia show model. A high-class piece of furniture worthy of the finest combinations of radio and gramophone.

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Harmonises with any style of home furnishing. Absolutely non-resonant. Suitable for all types of standard receivers or constructors' kits.

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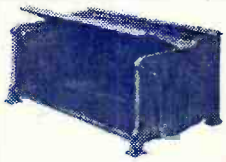

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The Wireless World

AND RADIO REVIEW

4D

The Paper for Every Wireless Amateur

Wednesday, December 10th, 1930.

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C. F. & H. BURTON, WALSALL, ENG.

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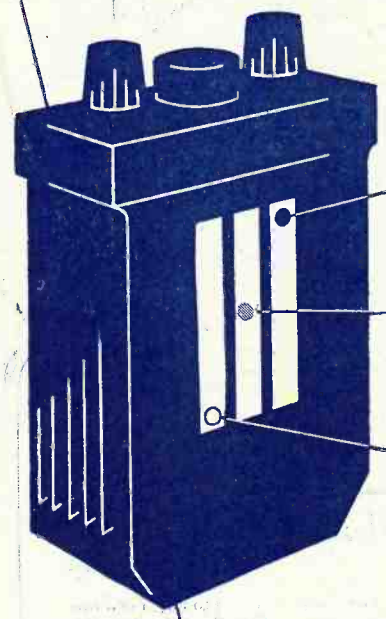

RED down
Save sorrow
Recharge
tomorrow

The charge
is lean
When falls the
GREEN

To charge
me right
Bring up the
WHITE

Think of it! No more exhausted accumulators. Here is a wonderful invention that removes all guesswork at once. Three little balls — red, white, green — floating in the acid, show its internal state at a glance. Warn you in plenty of time when recharging is due. Cut out distortion. Keep the programme running smoothly! This simple, marvellous device is owned solely by National. A new winter of wireless is at hand. Get an all-British 'Dagenite' — made by National.

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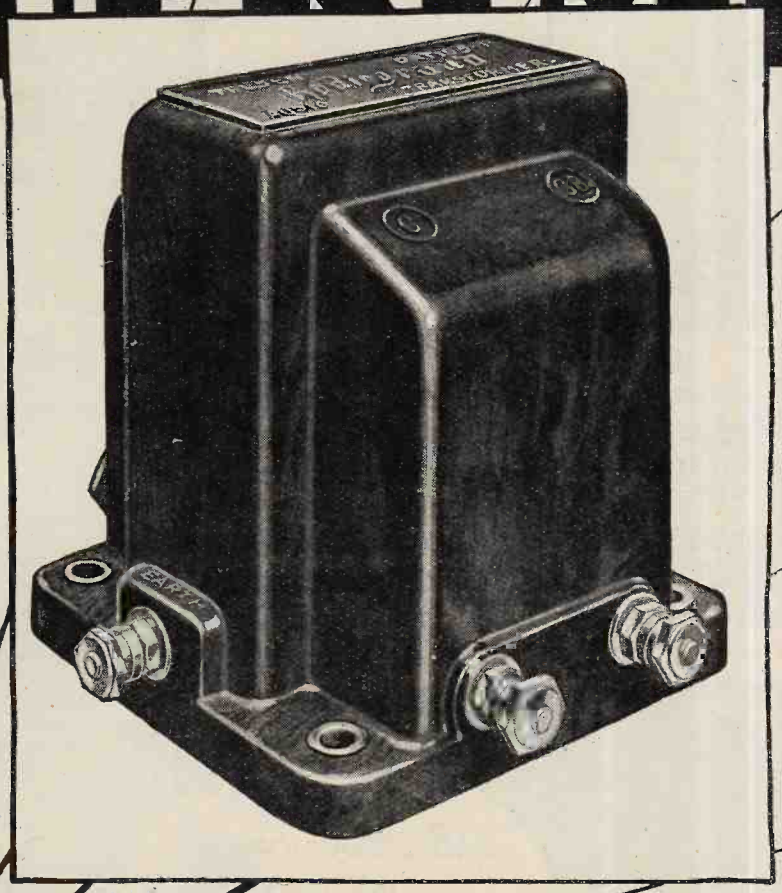

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OAK 40 gns. MAHOGANY 43 gns.

Mahogany Model

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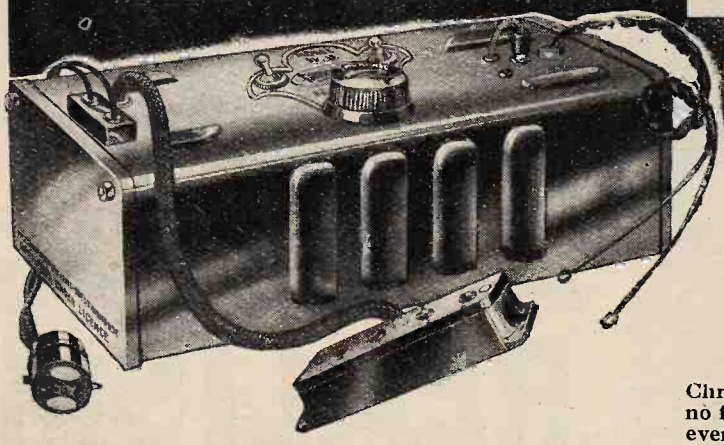
WITH REGENTONE



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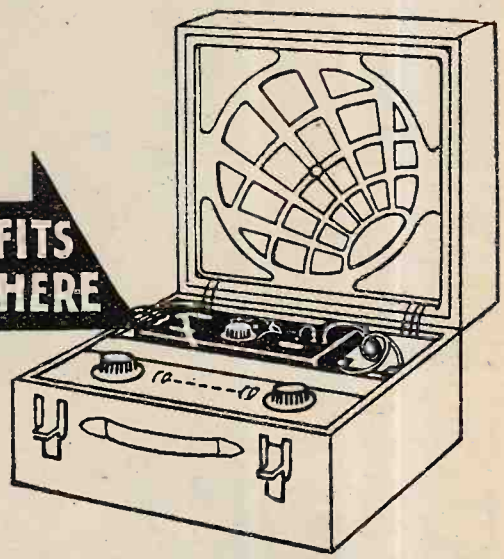

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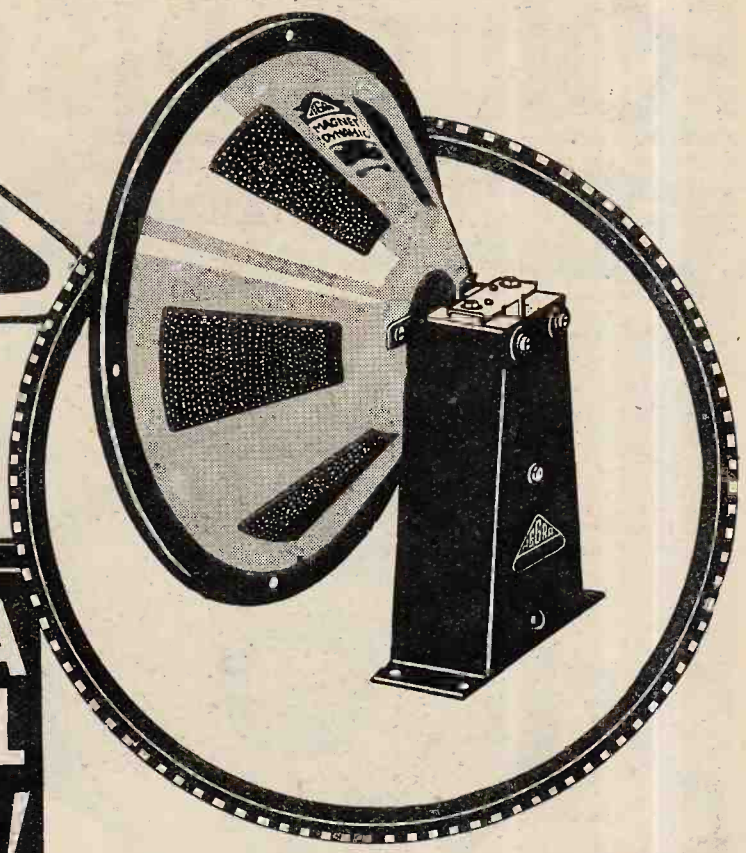

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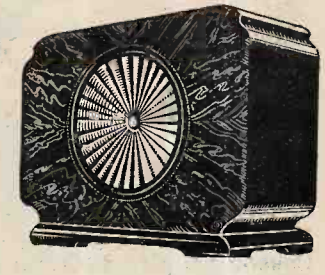
Note.—Both the Hegra Magnet Dynamic and the Cabinet Speakers are fitted with a triple lead, giving different impedance values according to the output valve used.



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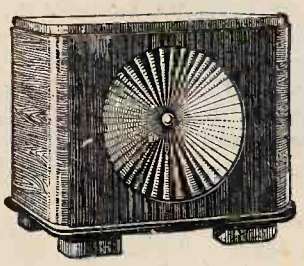
Incorporates Hegra "E" unit in handsome walnut cabinet .. **£3 . 5 . 0**



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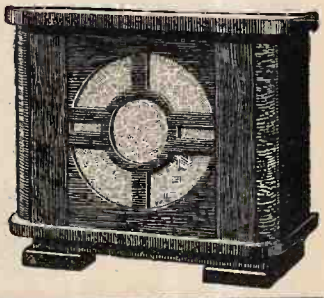
Similar to above, but with different cabinet design .. **£2 . 12 . 0**



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M.C. 21

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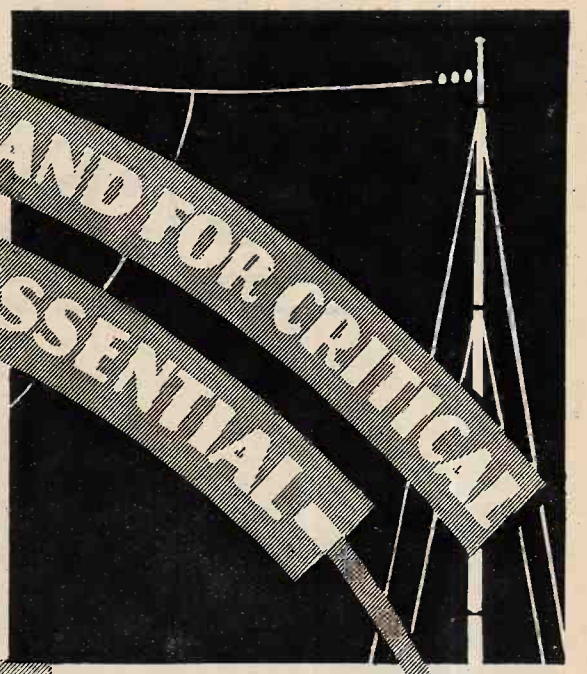

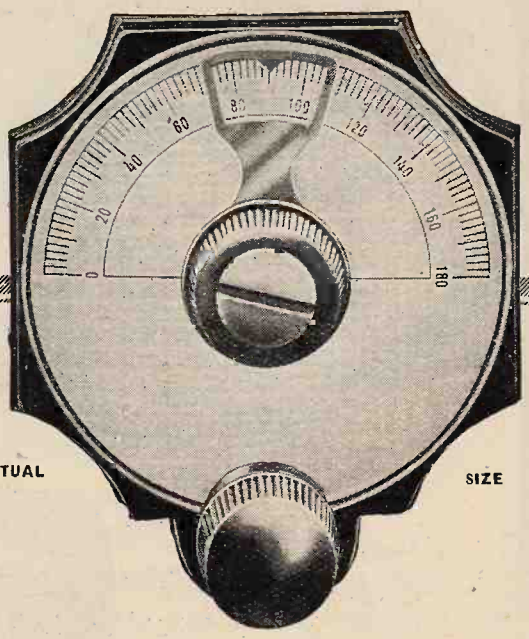

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SLOW motion or fast, but always a smoothness of action that reveals absolute precision in every part. This new Ormond geared dial is not only an invaluable asset to the working of any receiver but also greatly enhances its appearance. The frame is constructed of best quality bakelite of great strength, highly polished. Both fast and slow motion are provided. The former by pulling out the lower driving knob thus throwing drive out of gear enables central bush knob to manipulate the condenser spindle direct. Slow motion is obtained by giving the lower driving knob a slight cant towards centre knob, and pressing into gear, then operating in the usual manner. The Aluminium dial is in direct connection with the heel screw, and a Terminal is provided for separately earthing the dial; the latter may then be used as an anti-capacity earthing shield. Ratio approx. 10 to 1.

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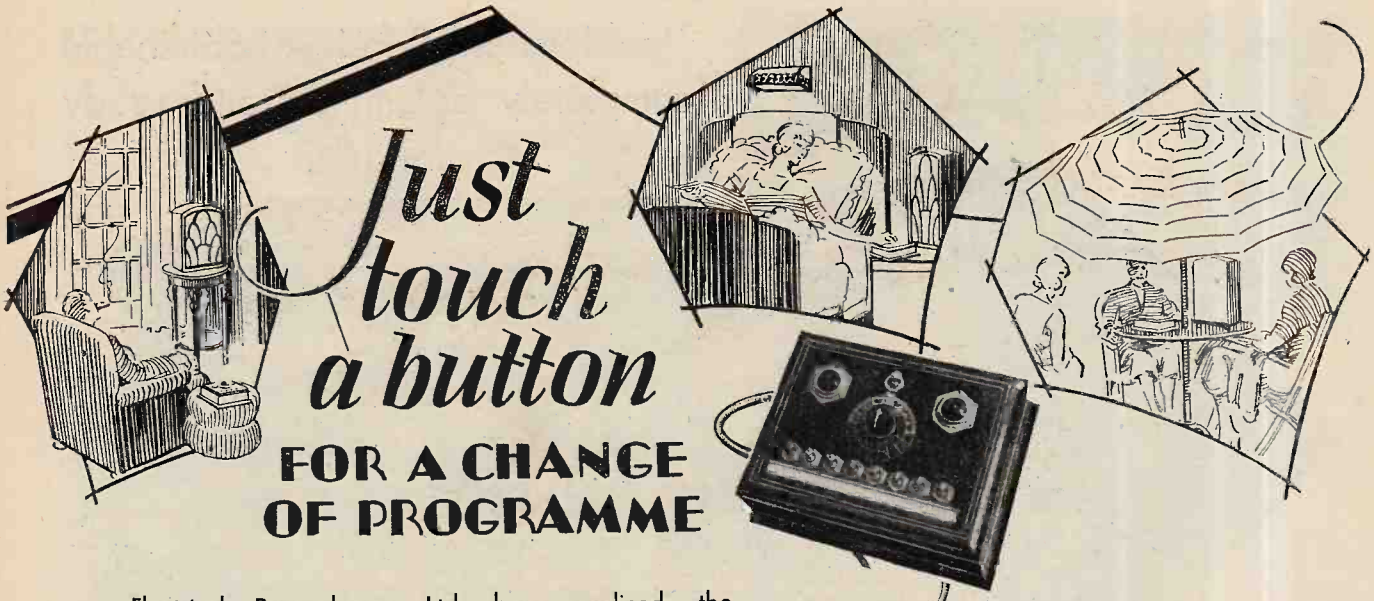

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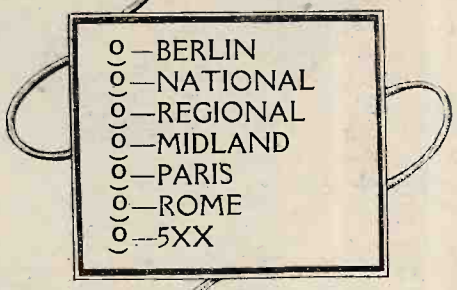

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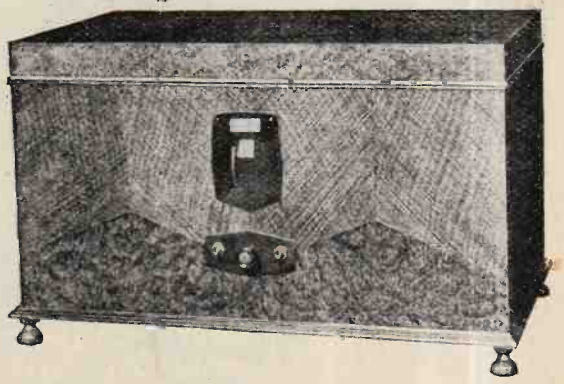

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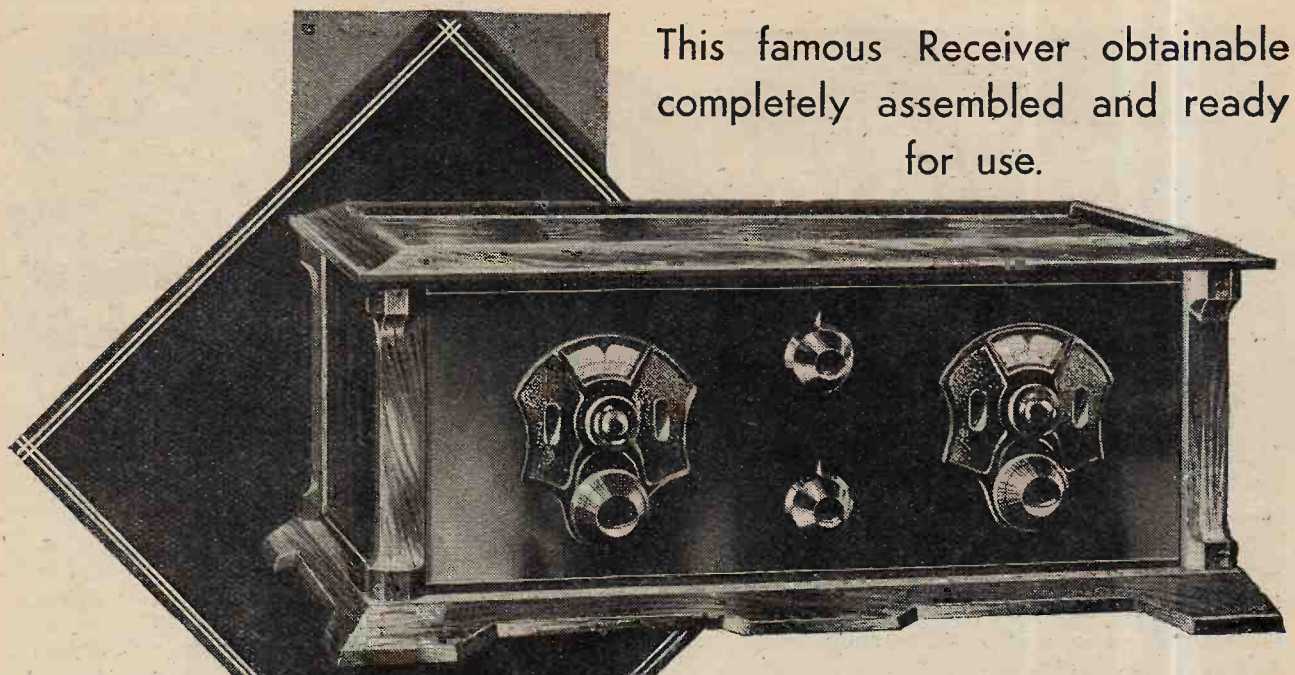

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Tunes in to every broadcast wavelength 15-2,000 metres.

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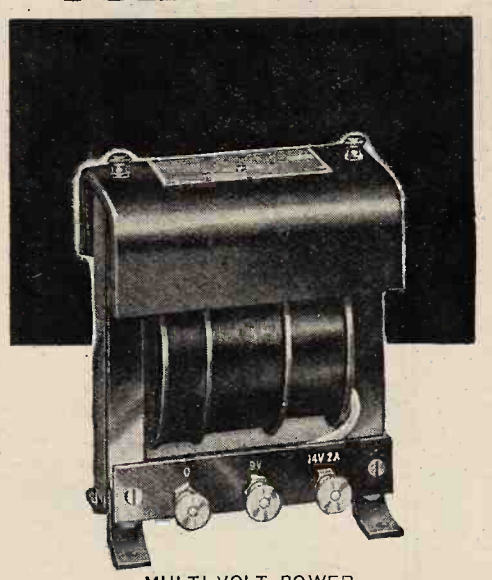

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MULTI-VOLT POWER TRANSFORMER

For Westinghouse Metal Rectifier—50 watts. Output 135 volts 100 m/a : 14/9 volts 2 amps.

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For Valve Rectifier—120 watts. Designed to supply ample power for the output stage of a public address outfit.

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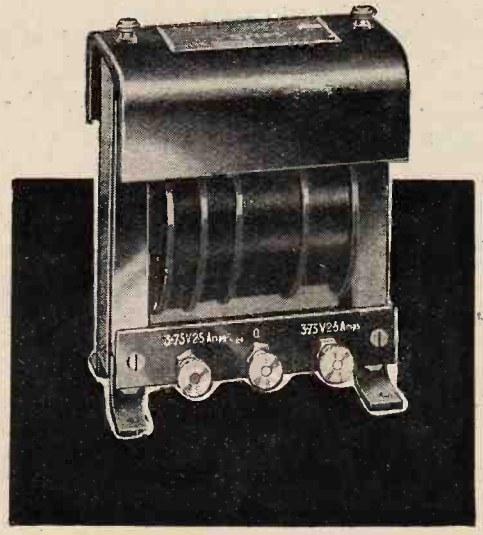

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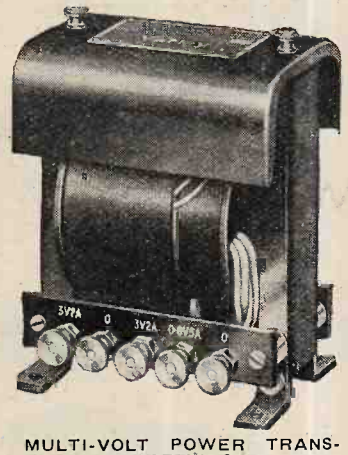

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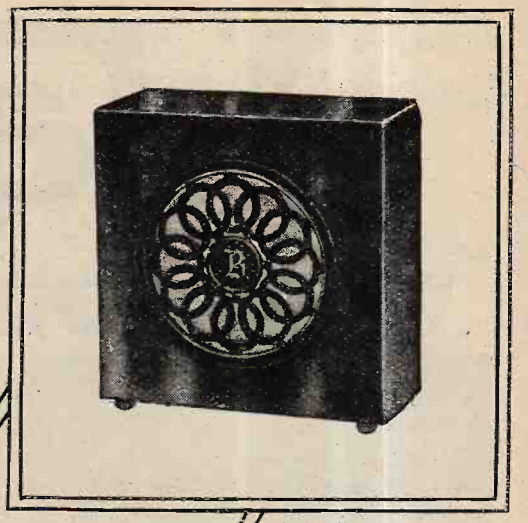
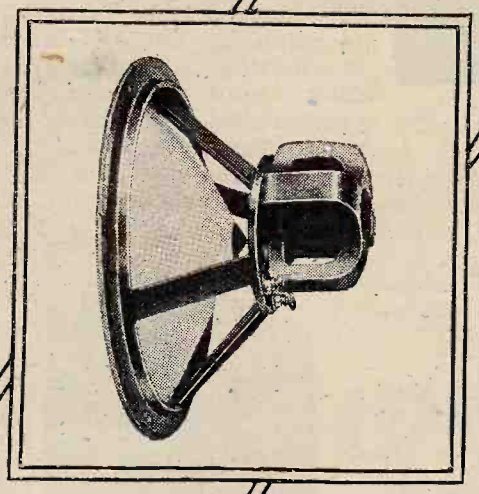


Brown "Peke" Moving Coil Movement

Here is the latest Brown achievement—a new Permanent Magnet Moving Coil Movement for only £4. 4s. The new Brown "Peke" is the result of lengthy research and experiment in the Brown laboratories. It gives real moving coil quality — reproducing the low notes richly and fully, without a trace of artificiality, and the high notes purely and sweetly. Yet its price is only **£4.4s.**



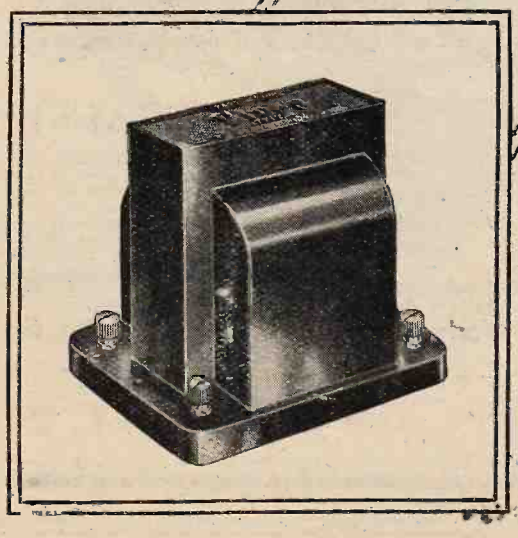
In Handsome Walnut Cabinet

The Brown "Peke" Moving Coil Movement can be fitted to any Receiver. It is also supplied in the handsome walnut cabinet illustrated above. Complete in its case, the Brown "Peke" is a moving coil loud speaker without comparison at its moderate price of **£6.15s.**

Brown Transformer

—a real Precision Instrument

There is no better transformer than the Brown (illustrated here). There are others cheaper, but none that has such a high standard of performance. The constructor who wants the best transformer that money can buy will choose the Brown. N.P.S. curve proves its even response throughout the whole harmonic scale. The transformer is hermetically sealed against dampness in a handsome moulded case. Ratio 3.5 to 1. Type B. Price **17/6**



See the New Brown Super Pick-up and Tone Arm

at your Wireless Dealer's. Gives great volume with even quality of response. Tone arm designed to minimise wear on record.

Price £3 3s.

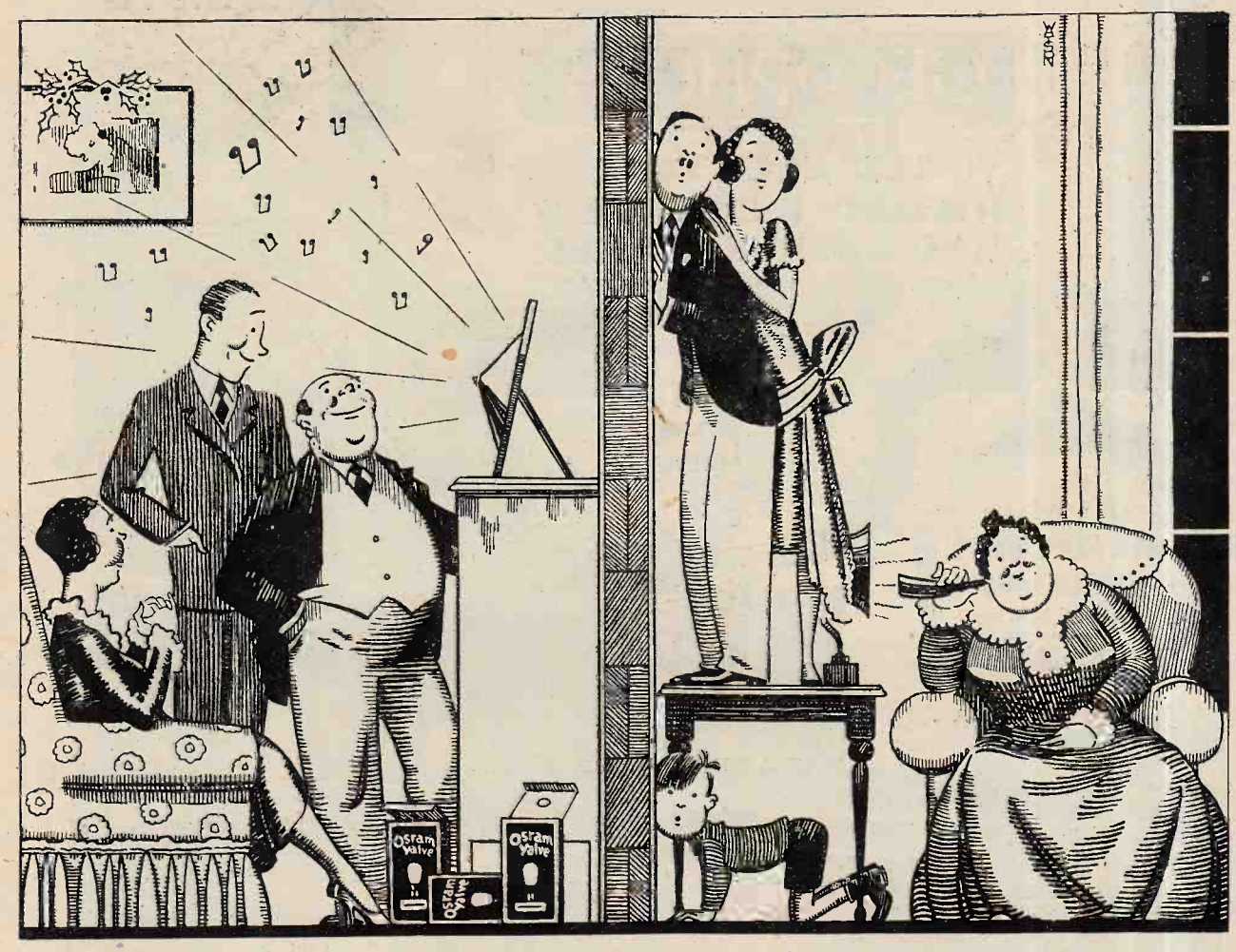
AS BRITISH AS BRITANNIA

S. G. Brown, Ltd., Western Ave., N. Acton, W.3.

♡6884

EVERYTHING The G.E.C. your guarantee ELECTRICAL

LISTENING *and listening*



Give THE *acceptable Xmas Gift*

Osram Valves

MADE IN ENGLAND

Sold by all Wireless Dealers

FOR ALL 3-VALVE SCREEN-GRID Sets

OSRAM S.215 - 20/-
OSRAM H.L.210 8/6
OSRAM P.215 - 10/6

they make ALL the difference

Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

EVERYTHING The G.E.C. your guarantee ELECTRICAL

Xmas will be all the merrier with a

GECoPHONE

REGISTERED TRADE MARK

ALL-ELECTRIC RADIO RECEIVER AND LOUD SPEAKER

"STORK" CABINET LOUD SPEAKER £3.5.0

3 valve ALL-ELECTRIC RECEIVER for A.C. MAINS £18

4 valve ALL-ELECTRIC RECEIVER for A.C. MAINS £30

MADE IN ENGLAND

Sold by all Wireless Dealers.

GECoPHONE

OTHER SUGGESTIONS FROM THE COMPLETE RANGE:—

2-VALVE ALL-ELECTRIC RECEIVER for A.C. Mains **£15**

RADIO-GRAMOPHONE for A.C. MAINS **£70**

PORTABLE RECEIVER All-Electric and Battery Models .. .. .. **20 Gns.**

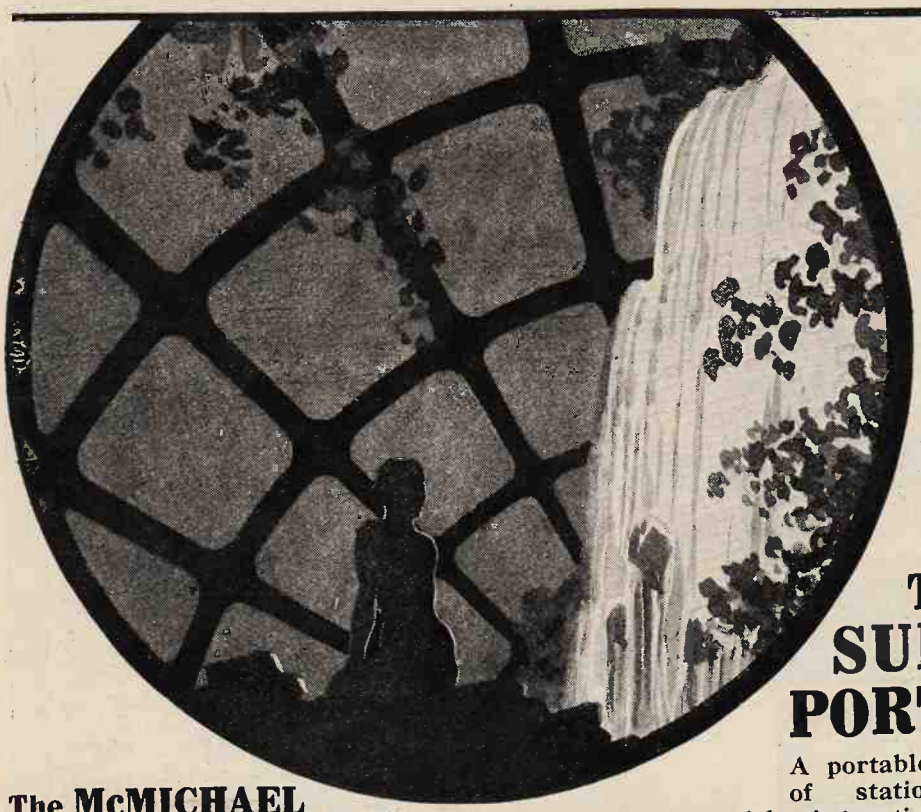
You can either buy your GECoPHONE for cash or Hire Purchase. Ask your dealer for particulars.

You MUST have the BEST for Xmas!

WRITE *for folder B.C. 5603 which gives full particulars of all GECoPHONE all-electric Receivers and Loud Speakers. Sent POST FREE on request.*

Advt. of The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2

VOLUME - WITH SPARKLING CLARITY



A never ceasing source of admiration and pleasure. McMichael receivers offer crystal clear reception of the widest range of stations combined with a mighty volume and an ease of control which ensures unequalled results.

The McMICHAEL SUPER RANGE PORTABLE FOUR

A portable offering the widest choice of stations in combination with handsome appearance and lasting satisfaction.

Outstanding details are: Screened Grid Amplification giving the widest range and the maximum selectivity.

Remarkably simple control—single dial tuning and volume control.

Owing to exceptionally low battery consumption the receiver is very economical in operation.

Fitted in a handsome furniture hide suitcase with patent locking clips. Its appearance and quality make it worthy of the most luxurious surroundings.

Owing to the high degree of selectivity, we are able to guarantee complete selectivity between all main B.B.C. stations under the regional scheme of wavelengths, *as proved by an actual test under the twin aerials at Brookman's Park, when both programmes were received separately without interference, as also a number of other British and foreign stations.*

This test was made on a standard "Super Range Four" Receiver, under independent Press observation, and was repeated at half-mile intervals with similar results.

Ask at any high class Radio store for a demonstration, or call at our London Showrooms, 179, Strand, W.C.2.

The McMICHAEL ALL MAINS THREE

A smooth and constant flow of power, every fraction of which is scientifically applied to its particular function, supremely simple in its control, profoundly satisfying in its results—this is the new McMichael Mains Receiver.

No deterioration in results, because batteries are eliminated. No complicated installation—you just plug into electric light socket or plug and many stations are at once available.

Incorporating the latest valves. Single tuning control. Loudspeaker and Gramophone Pick-up jacks provided. In handsome Walnut Cabinet. Made in two standard types, 200-250 v. A.C. and 100-115 v. A.C.

Price 20 Gns.

(Including Valves and Royalties.)

L. McMICHAEL LTD

Manufacturers of Wireless and Scientific Apparatus

WEXHAM ROAD, SLOUGH, BUCKS.

Telephone: Slough 441-442. Telegrams: Radiether, Slough.

London Showrooms: 179, STRAND, W.C.2. (Telephone: Holborn 2468.)

PRICE 22 GNS.

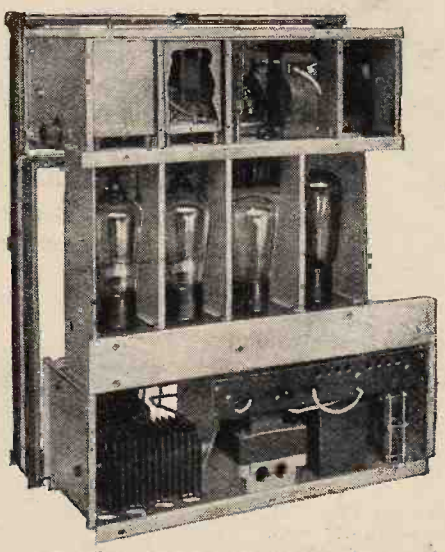
(Including all Equipment and Royalties.)

Or by our special "Deferred Payments on Hire Purchase Terms" system, £5 down and 10 monthly payments of £2 - 1 0.

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

The Westinghouse Metal Rectifier scores *another* triumph!

AT this year's Olympia, innumerable compliments were paid to the Pye "Twin-triple" A.C. receiver, which was placed first as the outstanding single exhibit; and also obtained first prize in Class 1 as the best receiver.



The Westinghouse Metal Rectifier is shown in the lower left-hand corner of this interior view of the set.

Pye fit the Westinghouse Metal Rectifier as standard.

In fact, it is noteworthy that most of the leading receiver-makers do so; for it contains nothing to wear out—no filaments, chemicals, nor moving parts.

It must be of definite interest to you to make sure that this rectifier is fitted in your set if you are a user of A.C. mains. Why not send 3d. in stamps for our informative, illustrated 40-page booklet, "The All Metal Way, 1931"?

SEND IN THE COUPON

THE WESTINGHOUSE BRAKE & SAXBY SIGNAL COMPANY LIMITED
82, York Road, King's Cross, London, N.1.

THE WESTINGHOUSE BRAKE & SAXBY SIGNAL COMPANY LIMITED,
82, YORK ROAD, KING'S CROSS, LONDON, N.1.

Please send your 40-page booklet, "The All Metal Way, 1931." I enclose 3d. in stamps.

PLEASE WRITE IN BLOCK LETTERS.

NAME .....

ADDRESS .....

.....

W.W. 10.12.30

IT'S yours, every corner of it, with its messages in music and speech, clear, resonant, natural and effortless. You are immediately master of the world, your hand controls your every wish, the tuner of your R.G.D. Radio Gramophone De Luxe is an "open sesame" to a radio feast of infinite variety. You will say that the Olympia Prize Winning R.G.D., giving the best of both radio and gramophone, is ideal for quality, and with the choice of over 30 stations—any of which is received with ample volume—makes it the ideal instrument for home entertainment.

THE R·G·D RADIO GRAMOPHONE DE-LUXE

Send for Illustrated Catalogue and literature. (Agencies vacant.)

Agents:
WEBB'S
164, Charing Cross Road, London, W.C.1.
and
133, New St., Birmingham.
RADIO EQUIPMENT CO. Huddersfield.
ALLCOCK, Fleet Street, Torquay.

QUALITY

VOLUME

IN OAK £80 IN MAHOGANY £85

THE RADIO GRAMOPHONE DEVELOPMENT COMPANY, 72, MOOR STREET, BIRMINGHAM.

"The Perfectavox"

"JUNIOR" MODEL

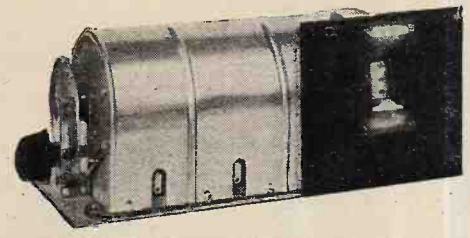
SCREENED GRID LION

Performance brilliant—full round reproduction. Circuit conforming to the very latest practise.
Screened Grid Valve (AC/SG) Det. and 1st L.F. (AC/HL). 2 P/650 Valves in Push Pull.
Moving Coil Speaker.
Electric Gramophone Motor.
Brilliancy Control to adjust tone to suit individual taste.
Automatic Stop operates efficiently on all makes of records.
Mains Aerial. An alternative connection so that the instrument can be used in any room even when no outside aerial is available. All Mains Operated. Send for illustrated folder of all models, and the name of your nearest dealer.

65 GUINEAS (in Oak).
68 Gns. Mahogany, 69 Gns. Walnut (as illustrated).
THE "PERFECTAVOX" SCREENED GRID "MINOR"
Oak, 47 Gns. Mahogany and Walnut, 50 Gns.

PERFECTAVOX LIMITED,
Alexandra Works, High St., Yeadon, LEEDS.

Here is the New POLAR "TUB" CONDENSER



The "Tub" shown fitted with Drum Dial reading but controlled by end drive.

This entirely new production, a triple-ganged fully screened condenser is designed expressly to meet the needs of modern multi-stage single control sets.

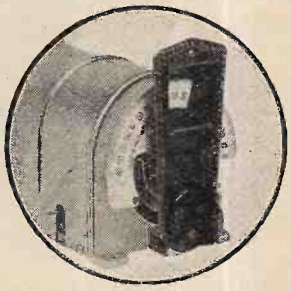
Three separate condensers are mounted on a common spindle and mounted in a die-cast frame. These are accurately matched, being guaranteed within 1 mmf. up to ·0001 and over that within 1%.

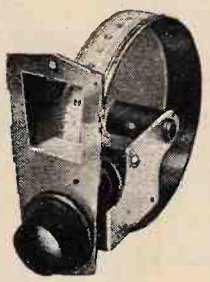
Trimmers are provided for any necessary adjustment. Each section is separately screened and totally enclosed, and each rotor independently earthed.

***Price* 30/-**

Disc Drive and Drum (as illustrated) - 37/6
With Polar Drum Drive, 38/6. With Polar Disc Drive, 35/-

POLAR DISC DRIVE.
Illustration shows the "Tub" fitted with the Polar Disc Drive, a knob control slow motion with scale behind panel. Very smooth action; easily read scale 0-180. Metal escutcheon, bronze finish .. .. **Disc Drive 5/-**





POLAR DRUM DRIVE.
An improved slow-motion drum drive with smooth, yet precise, action. Clearly marked scale, 0-180. Suitable for single or ganged condensers mounted parallel to panel .. .. **Drum Drive 8/6**

24-PAGE CATALOGUE FREE ON REQUEST.

WINGROVE & ROGERS, LTD.
188-189, STRAND, LONDON, W.C.2
Polar Works, Old Swan, Liverpool.

POLAR

£20 in Christmas Present Prizes

Simple Competition for Readers of "The Wireless World"

HIDDEN ADVERTISEMENTS

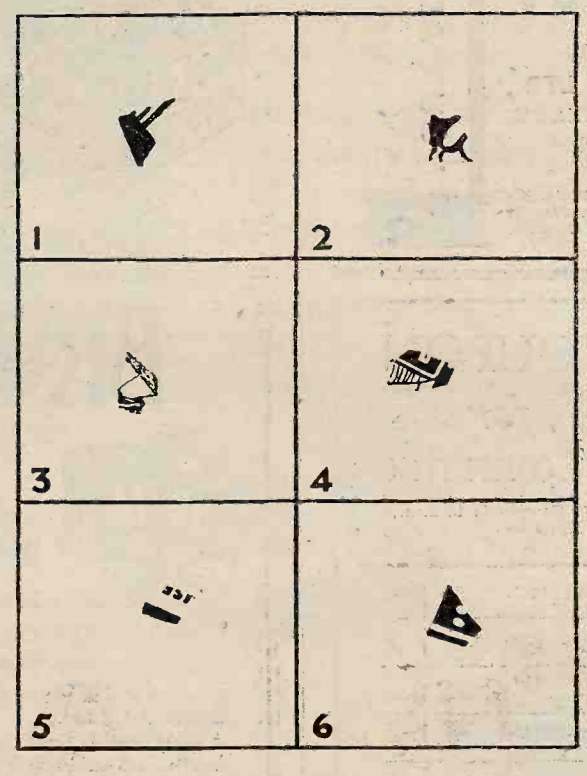
Below will be found six reproductions of fragments taken from the Advertisement pages of this issue of "The Wireless World." Each fragment is a clue. Can you from these clues identify the Advertisements? Eight prizes will be awarded in accordance with the conditions printed below. No technical skill is required, merely observation. There are no restrictions or entry fees and the conditions are simple.

First Prize

An order entitling the winner to purchase goods as advertised in this number of "The Wireless World" to the value of

£7.10s.

for the first correct solution opened.



Second Prize

An order entitling the winner to purchase goods to the value of

£5

for the second correct solution opened.

Third Prize

An order entitling the winner to purchase goods to the value of

£2.10s.

for the third correct solution opened.

5 Consolation Prizes

of goods to the value of

£1 each

for the next five correct solutions opened.

CONDITIONS

1. All solutions must be written on the special coupon appearing on an advertisement page in this issue and addressed to *The Wireless World*, Dorset House, Tudor Street, London, E.C.4, and marked "Hidden Advts." in bottom left corner.

2. Clues will not, of necessity, appear in the same way as in the advertisement page, but may be inverted or placed in some other position.

3. In order that town and country readers may compete on equal terms, solutions will not be dealt with until 10 a.m. on Monday, December 15th. All solutions received before that date will be retained until Monday morning. Competitors may submit any number of entries. Erasures or alterations on a coupon will disqualify the entry.

4. The first prize of £7.10s. will be awarded for the first correct solution opened; the second prize of £5 for the next correct solution; the third prize of £2.10s. for the third, and five consolation prizes of £1 each for the next five correct answers. In the event of no readers sending correct solutions the prizes will be awarded to the competitors whose solutions are most nearly correct.

5. The decision of the Advertisement Manager of *The Wireless World* is final and no correspondence can be entered into. Competitors enter on this distinct understanding. No member of the staff of the paper is permitted to compete.

YOUR NAME.....

SEND FOR PARTICULARS OF THE

LANCHESTER MOVING COIL COBALT STEEL SPEAKER

£4 : 4

COMPLETE

WRITE TO-DAY

LANCHESTERS LABORATORIES LTD., SPRING RD., TYSELEY, BIRMINGHAM.

This Speaker is NOT obtainable through any trade channels. It is sold only DIRECT TO THE PUBLIC.

YOUR ADDRESS.....

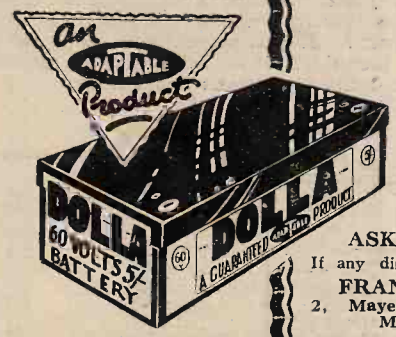
Get one for Xmas!

The DOLLA

HIGH TENSION BATTERY

5/- 60 VOLTS

"The Wireless & Gramophone Trader" Test Report, Nov. 1, 1930, says—
"EXTREMELY GOOD VALUE FOR MONEY— . . . . WE CAN RECOMMEND IT."



Don't let your enjoyment of the Xmas programmes be spoiled by a run-down, crackling H.T. Battery. Make certain of Power in Plenty by getting the "Dolla" H.T. Battery. Power that is Pure and Undistorted.

ASK YOUR DEALER.

If any difficulty, send direct to

FRANK SANDLER,
2, Mayes Street, Shudehill, MANCHESTER.
'Phones: Blackfriars 5065, Central 7692.
One of the Pioneers of the Battery Trade in this Country.

Sole Distributors of the Famous "ADAPTABLE" BATTERIES.

The Wireless World AND RADIO REVIEW COUPON for "HIDDEN ADVT." COMPETITION

The latest time for receiving this Coupon is 10 a.m., Monday, December 15th, 1930.

Clue No.	Name of Advertiser.	Page
1		
2		
3		
4		
5		
6		

I enter the above solution subject to the published rules.

Name _____
(Please write clearly)

Address _____

BROOKES MFG. COY. LIMITED.

Retail Price 2/6 each and 9d. each.

The BROOKES Aerial Mast Combination and Pulley.

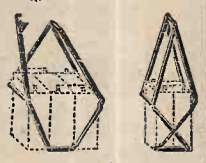
A device to save taking down pole when aerial is broken. Will fit masts of varying thickness from 1½ in. to 3 in. Provision is made for stay ropes and even pull all round is obtained.

The BROOKES Convertible Accumulator Carriers.

Supplied in sizes to take 4/6 volt and 2 volt accumulators.

A safety catch is fitted and prevents handle being accidently detached.

Retail Price - - 1/6 Large.
" - - 1/- Small.



Nº 1D

Also copper earth tubes, grid bias battery clips, etc.

The BROOKES Double Sided Turntable.

Beautifully finished in gilt. 7 ins. diam. A most useful accessory for portable sets and gramophones.

Retail price 5/- each.

"ETNA WORKS," 222-224, LICHFIELD ROAD, ASTON, BIRMINGHAM.

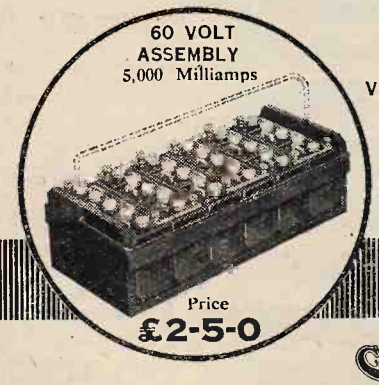
List and terms sent on application.

We're giving Father a new H.T. for our radio

I'm sure nothing will please him better—or us! From the time that we first had the wireless set Dad has continually preached the virtues of what he calls a wet H.T. of the C.A.V. make; how it will improve reception by cutting out those funny crackling noises, and then he goes on to talk about less trouble, constant volume and all that.

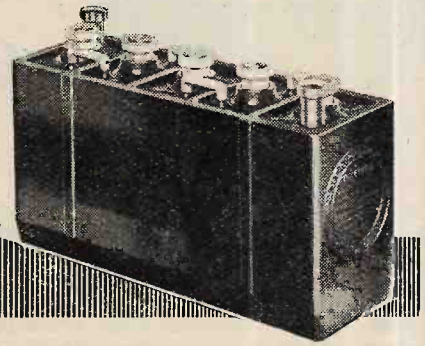
Anyway, if all the things are true that he said about the new C.A.V. type, the one which he says is "built like a car battery" it will be a good investment. So we have taken the hint, and I'm certain that the improvement will make it worth while, for Dad does know what he is talking about on the subject of wireless.

It's a C.A.V. of course



10 VOLTS **6/3** 5000 MILLIAMPS

ALSO IN 2500 & 10,000 MILLIAMPS



WRITE FOR CATALOGUE H.4.

C.A.Vandervell & Co. Ltd.
ACTON, LONDON, W.3.

SPECIFY THE C.A.V. JELLY ACID BATTERY—THE PERFECT L.T. FOR ALL PORTABLES.

The Experts' Choice — Why not yours?

SELECTED by experts in "The Wireless World" Olympia Competition as the finest Mains Units of the year, no finer Xmas Gift to yourself, or friends can be imagined than an "ATLAS" Mains Unit.

No matter what the Set is or whether A.C. or D.C. is in the home there is an "ATLAS" Unit to meet them. Made to the I.E.E. Regulations "ATLAS" Units are fully guaranteed for 12 months.

MODEL A.C. 188. This is the most amazing All-Mains Unit yet designed at the price and size. Combined H.T. Battery Eliminator and L.T. Trickle Charger it is suitable for any Set from one to five valves and especially suitable for the Mullard Orgola, Cossor Melody Maker, Osram Music Magnet and Red Star Sets. Provides special Tappings for Screen Grid and Pentode Valves, and gives Output of 150 Volts at 25 m/A. Incorporates Westinghouse Patent Metal Rectifier. Ask your dealer or write direct for Folder No. 55.

Cash Price **£6** or 10/- deposit and balance in easy monthly payments.

"CLARKE'S ATLAS" MODEL A.C. 188

H. CLARKE & CO. (M'CR) LTD., OLD TRAFFORD, MANCHESTER.

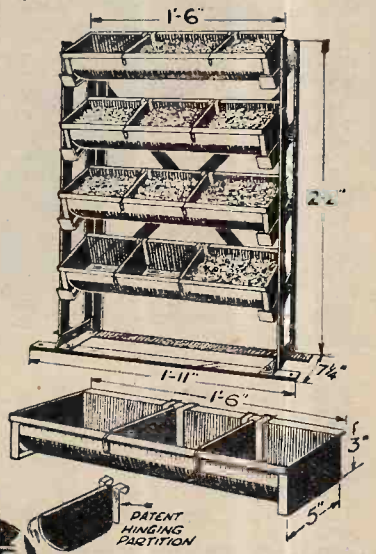
X'mas Presents

THAT ARE SURE TO PLEASE!

The lucky wireless man who receives one of these racks will be delighted. You could not receive a better present, nor could you give one. They are truly a boon and will be a constant reminder of the goodwill of the giver. Besides being a blessing to the wireless man they are extremely useful for motorists, as well as to the lady of the house. They save many a wasted hour searching for some small article—and encourage tidiness. Send your friends one for Xmas, and treat yourself to one also. *Write for Lists.*

THE "BENCHRACK" (Tiltrack Principle)

A real help for storing small parts such as Terminals, Nuts, Washers, Insulators, etc. Made to stand on the work bench, it enables all small parts needed for the job in progress to be stored where they are immediately to hand. All the trays are tilted so that the parts stored can be seen at a glance, and the front faces of the trays are rounded so that the smallest parts can be swept up the slope with the fingers of one hand. Each tray is provided with patent hinging partitions which can be moved quickly to make larger or smaller compartments. Being so accessible, these racks greatly facilitate stocktaking and being all steel there is no danger of fire. The experimenter will do his jobs much quicker and with greater pleasure, and the Factory will save many pounds per year by installing this Benchrack.



30/- F.O.R.

"TILTRACK JUNIOR"

This all-steel rack is designed to hang against a wall or other convenient position, and is a most excellent rack for storing small parts. It is supplied complete with white canvas protective cover to keep out the dust. All the trays are tilted and have movable partitions.

30/- POST FREE.

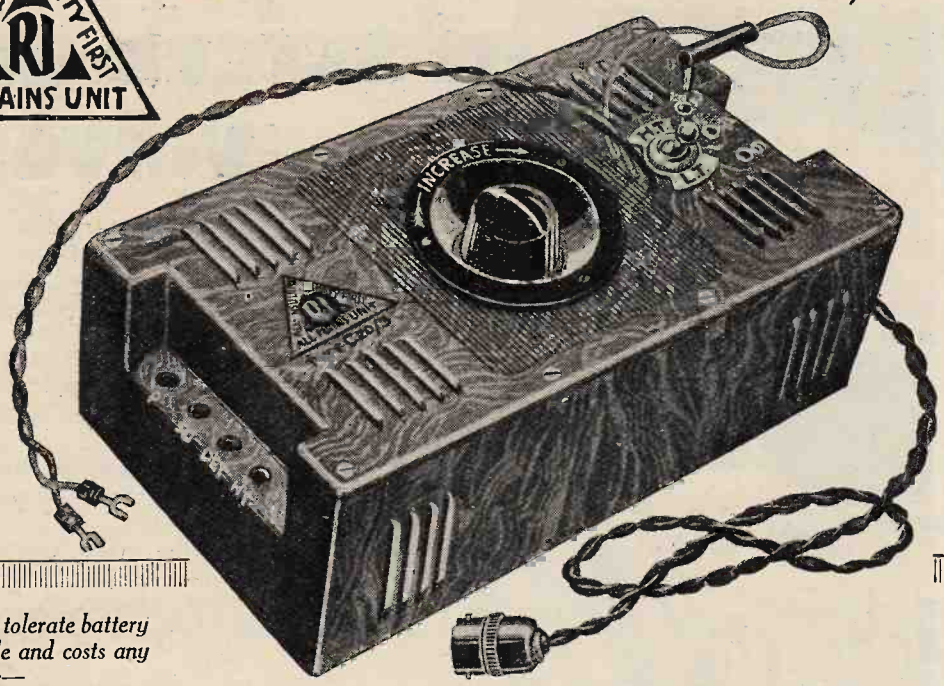
THERE ARE MANY MORE STYLES OF "TILTRACKS." PLEASE SEND FOR LISTS.

Particulars from Manufacturer & Patentee:— **BERTRAM THOMAS,** Worsley Street, Hulme, MANCHESTER.

*London Office & Showroom:—*28, Victoria Street, S.W.1.

All Electric Radio for Xmas

ALL-INSULATED SAFETY FIRST
RI
ALL MAINS UNIT



The Best as a Gift because—

The beautiful Walnut figured Bakelite case makes the R.I. All-Mains Unit most appropriate as a gift—it is completely insulated, therefore safest for inexperienced set owners.

Don't tolerate battery trouble and costs any longer—

Convert your set into "All Electric" with the

LATEST & BEST ALL-MAINS UNIT

Although only as big as the smallest H.T. battery, 9″ × 5″ × 3″, the RI combined L.T. and H.T. Unit supersedes all in efficiency.

SUPER-RELIABILITY is assured by the employment of **specially large and robust components,** the necessary space for which is alone made possible by the employment of **small, but marvellously efficient chokes** in which are incorporated cores of that amazing metallurgical discovery—**NIKALLOY.**

McMichael's, by recommendation, have testified to the pre-eminent suitability of this new all-mains unit for use with portables.

Also, many users of popular receivers, including the Osram "Music Magnet Four," have been lavish in their praise of the R.I. Unit, and have declared that it **marvellously improves their set performance** and standard of reproduction.

Now, make sure of your Xmas radio*—dispense once and for all with H.T. battery inconveniences and high costs. *Convert your portable, kit, or standard set into "All-Electric" and enjoy radio in the modern way. Compare with any other before buying.

ALL-MAINS UNIT.
H.T. output 120/150 volts, 20 milliamps. Charges L.T. accumulator either 2, 4 or 6 volts at ½ amp.

C 20/3 for A.C supply
£6.0.0

H.T. MODELS.
D 20/3 for D.C. supply
£2.12.6
A 20/3 for A.C. supply
£4.15.0

Both H.T. types give output of 140 volts, 20 milliamps.

Although rated at 20 milliamps the D.C. model actually gives 30 milliamps.

Ask your dealer to demonstrate a model and provide you with full descriptive leaflets.

If any difficulty, write to us direct, giving the name of your nearest radio retailer.

Accept no Unit that RI LTD does not bear this mark

MADRIGAL WORKS, PURLEY WAY, CROYDON T.A

 Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

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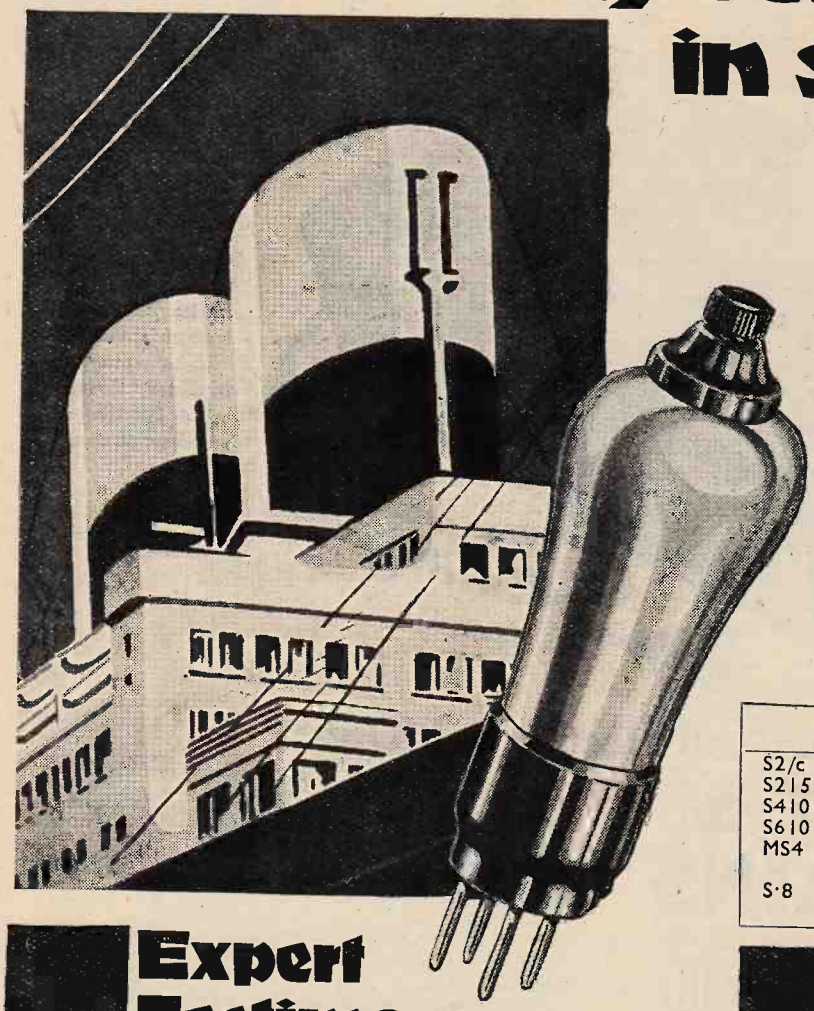

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Public Testimony

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—J. S. W., Southsea.

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The Wireless World

AND RADIO REVIEW

(18th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Radio Gifts for Christmas

AT the time of writing, Christmas is but three weeks ahead, and all of us are involved, to a greater or less degree, in the problem of contributing our part towards making the season a festive one and observing the time-honoured custom of giving presents amongst our family and friends. We know from experience that the task of selecting gifts is by no means an easy one, especially if the choice is to be made intelligently and we are determined that the gift we make shall be appropriate and appreciated.

We take this opportunity of reminding all our readers that wireless can provide the subject of our presents with probably no need to go outside its sphere in order to please all those who are to be the recipients of our tokens of goodwill. It would probably be difficult to find any individual in this country who is not in some way interested in wireless, either as a listener, an amateur, or even an engineer who has chosen wireless as a profession. The mere fact that we are readers of *The Wireless World* should provide the incentive to do all we can to increase the popularity and extend the influence of our particular interest, so that we would like to feel that every reader undertakes that the majority, if not all, of his gifts this Christmas will be suggested as a result of this reminder.

There is an enormous variety of wireless articles from which to select—a variety both in interest and in price—so that gifts from the most expensive even down to the humblest are available. In giving wireless as a Christmas present we have the added satisfaction of knowing that we are making a present which is going to provide a more or less permanent subject of interest instead of being, as is the case with so many Christmas gifts, either quickly consumed or otherwise liable to be forgotten after giving pleasure for a very short time. In the case of a family present, wireless offers the opportunity of giving something which will be welcomed as a joint family gift, for wireless is enjoyed by all members of the family, instead of dividing the sum to be expended in a number of smaller and less important items.

Broadcasting provides to-day what is unquestionably the cheapest possible form of entertainment all the year round, and if we present a friend with a wireless set or an accessory which provides the means of giving the permanent interest and entertainment which the programmes offer, it is as if, in addition to our initial gift, we are presenting our friend with season tickets for a variety of concerts and other entertainments for a long time to come. It would probably be impossible to imagine any other Christmas gift which carries with it the promise of so much entertainment for the future.

We take this opportunity of conveying to all our readers sincere wishes for Christmas and the New Year from all members of the staff of *The Wireless World*.

In This Issue

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UNBIASED OPINIONS.
CURRENT TOPICS.
THEORY OF THE VALVE AMPLIFIER.
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LETTERS TO THE EDITOR.
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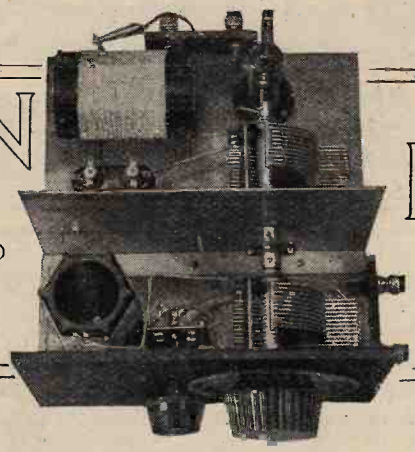
REACTION and the BAND-PASS FILTER



How the Resonance Curve is Affected.

By W. T. COCKING.

BEFORE the commencement of the Regional scheme, one of the most popular local station receivers was a three-valve combination of a screen-grid H.F. stage, with an anode-bend detector, and either a triode or a pentode output valve. When such a receiver includes fairly efficient coils, a high degree of selectivity can be obtained, and the amplification is sufficient to allow of a number of the more powerful Continental stations being received.

The set has numerous faults, however, among the more important of which is the considerable high-note loss associated with sharply tuned cascade circuits and the amplitude distortion usually occurring with anode-bend rectification. The higher power of the latest broadcasting stations, moreover, has rendered the amplification of such receivers excessive for local listening, while the introduction of the power-grid detector has overcome the trouble from amplitude distortion, and at the same time increased the sensitivity of the set.

In many cases, therefore, it is now found that a two-valve receiver, consisting of a power-grid detector with a pentode, or even a triode, output valve, will give amply sufficient volume for ordinary purposes. Indeed, such a receiver will work a moving-coil loud speaker at quite large volume at distances up to twenty-five miles from a high-power transmitter, provided that a good aerial be used. Following the usual design, however, such a set would have but a single tuned circuit, and it is readily demonstrable that, unless the coil resistance be exceptionally low, the selectivity is totally inadequate to separate the two London transmitters. Any attempt to increase the selectivity by the use of a very low-loss coil (obtained, in practice, by the use of reaction to counteract added damping) results in a large high-note loss; and one of the chief advantages of the circuit, the high quality which is readily obtainable, is lost. The solution of the problem lies in the use of the band-pass filter, for a high degree of selectivity is then obtainable without a high-note loss.

MANY readers have probably been puzzled by the peculiar effect of reaction on a band-pass filter. With a capacity-coupled filter it may happen that at the higher wavelengths signal strength is actually reduced, whilst at the lower end of the waveband the application of reaction brings about the normal increase in selectivity and volume. These effects are fully explained in the accompanying article and consideration is given to the conditions under which reaction can be usefully employed in a filter.

Filter Characteristics.

The theoretical design of band-pass filters is not as simple as might be supposed, for there are many conflicting factors to be taken into consideration. Apart from such desirable characteristics as constant peak separation, high and constant efficiency, and high selectivity, there is the effect of reaction to be considered. The vast majority of two-valve sets with single-circuit tuning are fitted with reaction, for the reason that it gives increased sensitivity and selectivity at very low cost. Reaction, therefore, will usually be fitted to a set in which a filter is used for tuning, and it becomes of importance to determine the effect of reaction upon a band-pass filter.

The effects of reaction with ordinary single circuits are so well known that they need little discussion here. It is well to bear in mind, however, that the chief effect is usually considered to be a reduction in the circuit resistance. Although this may not be strictly accurate, it is sufficiently so for most purposes. The coil magnification of the single tuned circuit is given by the well-known expression $\omega L/R$, the ratio of reactance to resistance, and for a small solid wire coil it may have a value of 100, while for a low-loss Litz-wound coil it may be as high as 400. Now, when the circuit resistance is reduced just to zero by the application of reaction, the coil magnification becomes infinite; there is no limit to the amplification obtainable. In practice, of course, we cannot work with zero coil resistance for many reasons, the most important of which is that self-oscillation occurs. Thus there is a definite limit to

Reaction and the Band-Pass Filter.—

the amplification obtainable by the use of reaction, but the point of particular importance is that the gain is unlimited when the coil has no resistance.

It might be thought that the effects of reaction upon a band-pass filter would be identical; this is not the case, however, and, in practice, the effects are often puzzling. The signal strength is not increased to anything like the extent which one expects, and, in addition, the double-humped tuning effect is markedly increased, so much so, in fact, that a station can only be received loudly at the two settings of the ganged condensers corresponding to the two peaks, and is much reduced in signal strength at the correct setting, which is midway between them.

The circuit of a commonly used filter with a reacting power-grid detector is shown in Fig. 1, and in the Appendix will be found formulæ for the three important frequencies, the two peak frequencies and the resonance frequency, which correspond to the simple magnification expression for a single circuit. Now, if the effect of reaction be considered as reducing the circuit resistance, it is at once evident that the magnification at the resonance frequency is definitely limited, and reaches a maximum of C_m/C when the circuit resistance is zero. This is very different from the value of infinity for a single circuit, for under normal conditions the value of the expression is almost equal to that of a single circuit without reaction. In practice, therefore, we should expect to find that reaction gives only a small increase in signal strength when the circuits are tuned to resonance; this is, indeed, the case, and certain experiments which the writer has conducted tend to show that the increase of strength due to reaction is only some 40 per cent.

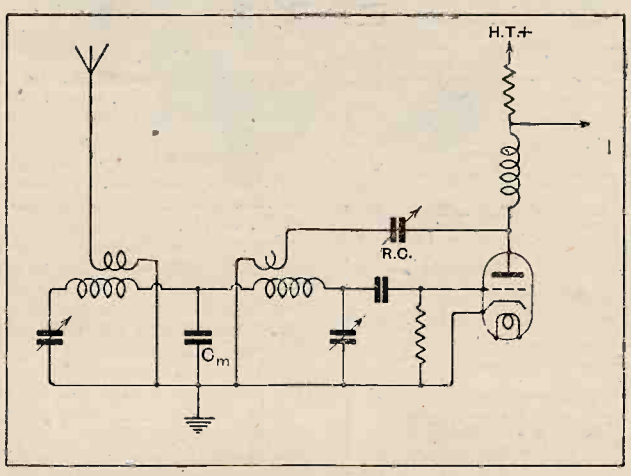


Fig. 1.—A simple capacity-coupled filter in which the tuning coils can consist of 80 turns of No. 26 D.C.C. close wound on a 2in. diameter former. The aerial and the reaction windings can be identical, and consist of 15 turns of No. 36 D.S.C. wound at the earthed end of the main winding. A suitable value of the coupling condenser C_m is 0.01 mfd., while the reaction condenser should have a capacity of about 0.0003 mfd. and the tuning condensers 0.0005 mfd.

The Peak Frequencies.

Quite different results are obtained at the peak frequencies, however, and the formulæ show that when the circuit resistances are zero the magnification is infinite—that is, the circuit would appear to be as efficient as a single circuit. This is not found to be the case in practice, however, and the reason lies in the fact that it is rarely possible to reduce the resistance of *both* tuned circuits simultaneously to a value closely approaching zero. In addition to this, the whole subject is complicated by the phase of the fed-back reacting currents, which is different for every frequency. The value of the effective circuit resistance, therefore, will vary over the important range of frequencies lying between the two peaks, and will never be the same at all of the three important frequencies. It would appear, therefore, that the simple method of considering the effects of reaction as reducing the circuit resistance is more inaccurate with filters than with single circuits.

In order to illustrate the effects of reaction, the experimentally determined curves of Fig. 2 are given. These are for the circuit of Fig. 1 at a frequency of 680 kc., with 200 mH. coils and a 0.01 mfd. coupling condenser. The AC/HL power detector had a grid condenser of 0.0001 mfd., and the grid leak of 0.15 meg. was deliberately connected in parallel with the second tuned circuit in order to throw a heavy load upon it, and so to emphasise the effects of reaction. The curve marked "no reaction" was taken with the reaction condenser disconnected, and a 0.002 mfd. condenser connected between the anode and cathode to reduce anti-phase feed-back to a minimum.

It will be seen that the effect of reaction is to increase the efficiency at resonance only by some 36 per cent., but that at the peak frequencies the efficiency is increased four times. The important effect of reaction upon the band width is also well brought out. Without reaction the peaks occur 15 kc. apart, but with reaction they are 51 kc. apart; as a result of this the use of reaction actually *reduces* the selectivity over a considerable range on either side of resonance. The circuit is strongly resonant to two widely separated frequencies at the same time, and, in fact, the only thing which can be said for reaction is that it does not spoil the quality!

Uses of Reaction.

This must not be taken to mean that reaction is useless; however; on the contrary, in spite of the faults which have just been discussed, there are cases where it is of definite advantage. The ordinary capacitatively coupled band-pass filter has neither constant peak separation nor constant efficiency throughout the broadcast band; the signal strength may drop off considerably below 300 metres. At some wavelength the double-peaked tuning curve disappears, and for all wavelengths lower than this the effects of reaction are entirely different, and more closely approach those associated with a single circuit. That is to say, reaction gives a definite increase in signal strength and increased selectivity while the response to the sidebands is reduced. With certain types of filter with mixed coupling, in which the resonance curve is nearly rectangular and without the double hump, reaction can be advantageously used.

Reaction and the Band-Pass Filter.—

Now it is apparent from the curves of Fig. 2 that when reaction is used with a capacity filter, a larger-capacity coupling condenser would give better results, since the peak separation would be reduced. This gives better selectivity without a loss of high notes, while at the same time increasing the efficiency. It is advisable, therefore, to use a fairly large-capacity coupling condenser when reaction is employed. The chief use of reaction, however, lies in counteracting added damping, such as the load imposed by a detector valve, for it is not very satisfactory when an attempt is made to work close to the oscillation point. It can be said, therefore, that the chief use of reaction with a band-pass filter is in the eliminating of anti-phase feed-back

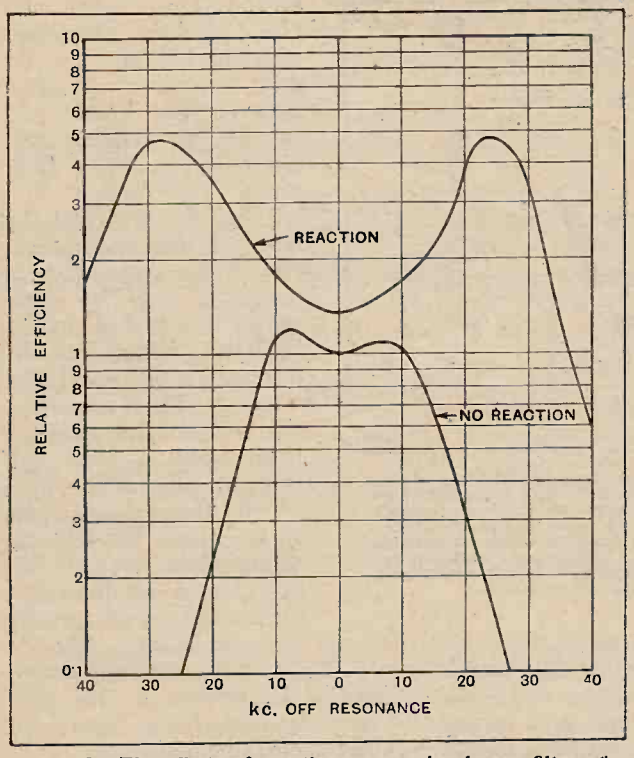


Fig. 2.—The effects of reaction upon a band-pass filter at 680 kc., 440 metres. The efficiency is only increased to a small extent, while the peak separation is considerably increased.

from the detector; indeed, it is somewhat better for this purpose than the usual anode circuit by-pass condenser, since reaction with a filter need cause no high-note loss.

APPENDIX.

The magnification of a band-pass filter at resonance is given by

$$\frac{e}{E} = \frac{1/\omega^2 CC_m}{R^2 + 1/\omega^2 C_m^2} \quad \ldots\ldots\ldots\ldots (1)$$

and at the two peak frequencies by

$$\frac{e}{E} = \frac{1/\omega^2 CC_m}{2R(\omega L - 1/\omega C)} \quad \ldots\ldots\ldots\ldots (2)$$

when R is small.

Where e = voltage developed across the secondary tuning condenser.
E = voltage injected in series with the primary circuit.
C_m = capacity of coupling condenser.
C = total tuning capacity.
L = inductance.
R = primary circuit resistance = secondary circuit resistance.
$\omega = 2\pi f$.

When R = 0, equation (1) becomes

$$\frac{e}{E} = \frac{1/\omega^2 CC_m}{1/\omega^2 C_m^2} = \frac{C_m}{C} \quad \ldots\ldots\ldots\ldots (3)$$

and equation (2) becomes

$$\frac{e}{E} = \frac{1/\omega^2 CC_m}{0} = \infty \quad \ldots\ldots\ldots\ldots (4)$$

NEW BOOKS.

Demonstrationsexperimente mit kurzwelligen und ultrakurzwelligen Schwingungserzeugern *(Lecture experiments with short-wave and ultra-short-wave oscillators).*—By W. Möller. (Rothgiesser and Diesing, Berlin.) Price RM1.

This little book, which is written in very easy German, is divided into four sections. The first deals with the construction of simple oscillators for generating short waves (12 metres upwards), and the second gives similar information for ultra-short waves (3 to 10 metres). The remaining two sections, which occupy about two-thirds of the book, are devoted to various experiments that can be carried out with the aid of the oscillators described. The experiments are ingeniously designed to illustrate the fundamental properties of tuned circuits and the principles of radiation from an aerial. Most of them require no more apparatus than a yard of wire and a pocket-lamp bulb, though in a few cases a galvanometer or milliammeter is desirable. With the exception of wavelength determinations from Lecher wires or from the dimensions of a dipole aerial, both the experiments and the discussions based upon them are purely qualitative in nature.

The points illustrated comprise the phenomena of resonance, the effects of added resistance upon the resonance curve of a tuned circuit, and the production of "double humps" by coupled circuits, while an ingeniously simple method of plotting the magnetic field due to a coil is also included.

No reader working through the experiments detailed in this book could fail to have a good grasp of the fundamental principles of wireless transmission and reception, and he would enjoy himself thoroughly in the process. A. L. M. S.

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A.T.I. (*Annuaire Telephonique International*), 1930. This International Telephone Directory has been greatly enlarged since the first edition was published last autumn, and now contains the names of more than 50,000 firms in 2,718 towns in 38 countries, as compared with 12,000 firms from 1,485 towns in the 1929 edition. The first part contains general information concerning the International telephone service and a list of charges between the principal towns of Europe. The second part comprises a classified list of traders and hotels, followed by an alphabetical list of names. The general information is given in English, French, German, and Spanish. The directory is published in Copenhagen, and the sole agents for Great Britain are Messrs. Rassey Bros., 28, Basinghall Street, London, E.C.2.

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A Catalogue of British Scientific and Technical Books. New and revised edition, comprising books published by British firms and in their lists up to September, 1929. The sections devoted to general physics and to electrical engineering cover 41 pages, of which the sub-section relating solely to wireless telegraphy, telephony and television comprises the names of 118 books by well-known authorities. Pp. 754 + xxi. Compiled by the British Science Guild, and sold by A. and F. Denny, Ltd., London, price 20s. net.

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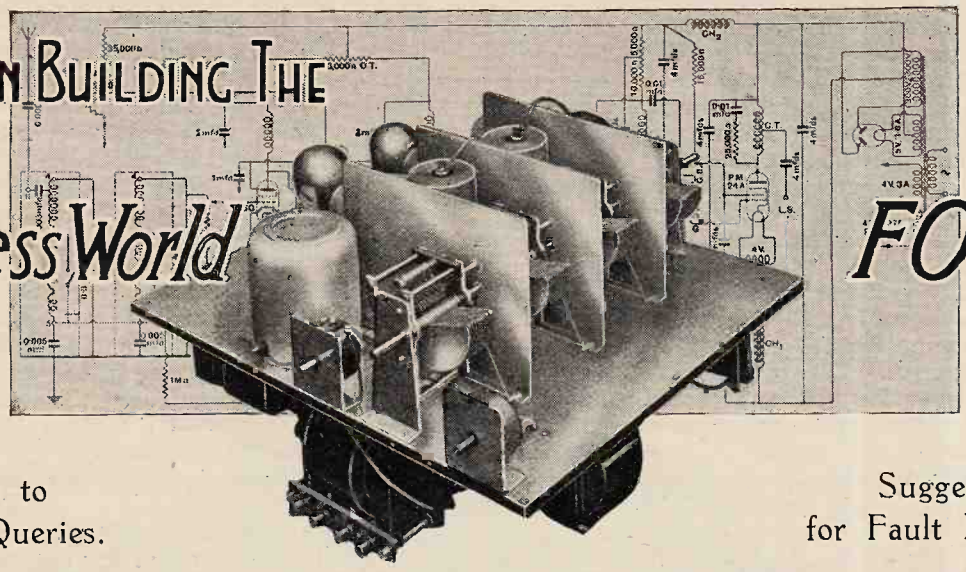
Handbook of Technical Instruction for Wireless Telegraphists, by H. M. Dowsett (fourth edition). Revised and greatly enlarged to meet the more exacting requirements of the sea-going operator's duties of to-day, and providing a complete theoretical course for the P.M.G. certificate. Pp. 487 + xix, with 462 diagrams and illustrations. Published by Iliffe and Sons Ltd., London, price 25s. net.

HINTS ON BUILDING THE Wireless World FOUR



Answers to Readers' Queries.

Suggestions for Fault Finding.

FROM the moment that details of The Wireless World Four* were given an overwhelming number of queries commenced to come to hand. Not one of the querists had built the set or had even secured the necessary parts, but their questions related to every conceivable form of modification to which a four-valve mains-operated set can lend itself. The need for these modifications could not be appreciated, and the introduction of any one of them would have crippled the original design and have necessitated many weeks of work in the development and trying out of the alternative.

It must be obvious that no departure can be made from the types of valves used. Not only are all the resistance feeds adjusted to suit the conditions of anode voltage and grid-bias of the particular valves specified, but the signal-handling properties of the valve, stage by stage, are taken into account. It can be said that a change in the type of valve specified can only bring about failure.

Some Common Queries.

The following are a few predominant questions dealing with modifications which can be quickly answered:—

Q. *Why not bias the H.F. valves by a resistance in the cathode lead?*

A. Because the grid leak bias system adopted brings about a biasing back of the grid potential by 1 volt for every microampere passed in the grid circuit of the H.F. valves as resulting from overloading. This prevents the detector being overloaded.

Q. *Why are tuned grid circuits used in preference to tuned transformers?*

A. This is essential in order to keep all the tuned stages identical. Tuned transformer stages in anode circuits of valves cannot be successfully gang tuned. Choke fed tuned grid circuits are selective and wave-range switching is simple.

Q. *Why are such high values of decoupling resistance used in the screen and anode leads of the H.F. valves?*

A. Because the amplification is rarely linear, and the rectification that takes place will at once give rise to L.F. oscillation unless decouplings effective to L.F. are adopted.

Q. *Would not the substitution of Litz wound coils be an advantage?*

A. No. Assuming that such coils when screened may still retain their low resistance a highly efficient tuned circuit in the anode of a valve reduces the maximum grid potential that the valve will accept without excessive rectification, thus bringing about a condition of flatness of tuning by the cross modulation of carriers.

Q. *Do not the screens tend to spoil the coils?*

A. No. Tests were made with a two-H.F. amplifier using both "good" and "bad" intervalve couplings, and the conclusion was arrived at that the best H.F. amplification, bearing in mind the need for reliability, complete screening, and the proximity of the short circuited long-wave section, was given by tuned circuits of about 120,000 ohms dynamic resistance. Coils and screens of various relative sizes were tested, and the best spacing between coil and screen determined. Those used give a dynamic resistance of 140,000 ohms at 250 metres, falling to 85,000 at 500 metres. On removing the screen, together with a few turns of the coil in order that the inductance may remain unchanged, we find that the dynamic resistance of the tuned circuit is not so good at 250 metres, being of the order of 120,000 ohms. The highest dynamic of the unscreened coil is at about 300 metres, where it reaches a value of 145,000 ohms. The measured inductance on the broadcast band of the coils is 160 microhenrys with a self-capacity of 10 $\mu\mu$F., and when the screen is removed the inductance increases to 182 microhenrys. The best spacing between the broadcast band coil and the long-wave winding was determined as a result of these tests.

Q. *Can a tuning condenser be used of alternative type to that specified?*

* The Wireless World Four, by F. H. Haynes, in the issues of October 15th and 22nd, 1930.

Hints on Building The Wireless World Four.—

A. In general, no. While other condensers are good in themselves they were not used in the development of this design. The condensers adopted not only have generous plate spacing, but it was found that all specimens tested had a precisely similar tuning scale with a limit of accuracy of one part in 200.

Q. *How is correct ganging obtained seeing that there are no trimming condensers?*

A. The purpose of a trimming condenser is not to compensate for differences in the coils. Only a logarithmic scale condenser can attempt to do that, and even then it is necessary for the zero capacity in all the tuned circuits to be identical and for the plate shape to be designed, assuming a stated self-capacity in the circuits. Well within the limits of accuracy required, the coils are matched to the stated value of inductance, while resistance and self-capacity are taken into account by a tuned circuit test with valve voltmeter. Thus with inductances and tuning condensers identical stray capacity only has to be considered. This was done by adjusting coil-tapping points and taking into account all the circuit and valve conditions which introduce capacity. Finally, the receiver was tuned right through its stages to a given wavelength, and by dropping each set of moving plates, in turn, back to zero, measurement with a standard condenser revealed that a zero capacity of precisely 60 $\mu\mu$F. was acting in each stage excepting the detector, where the value after adjustment of the tapping point on the coil was 58.5 $\mu\mu$F. Such a small difference may be neglected. The aerial capacity was taken as 0.0002 mfd., and the change brought about by the use of large or small aerials of values 0.0001 or 0.0003 mfd. is insignificant, being less than 12 $\mu\mu$F.

Q. *If the value of the band pass coupling condenser is correct on the broadcast band will it be unsuitable when the set is switched over to the long waveband?*

A. The amount of coupling on the long wavelengths provided by the 0.01 mfd. condenser is insufficient. This increases the sharpness of tuning and gives a peak separation less than that obtained on the broadcast range while slightly reducing the signal delivered to the grid of the first valve. It is explained, however, that slight misganging is not improbable on the long wave, so that a certain desirable degree of flatness of tuning will in most cases be inadvertently introduced. The cutting down of signal by using too loose a coupling is no disadvantage seeing that this has already been done on an extensive scale in the aerial circuit, and, in spite of it, it is possible to load fully the output valve when receiving the transmissions from all European long-wave stations. It must be remembered also that the high ratio of inductance to capacity as used on the long wavelengths produces intervalve couplings which give considerable H.F. amplification.

Q. *Why is the value of the H.F. biasing resistance 40 ohms?*

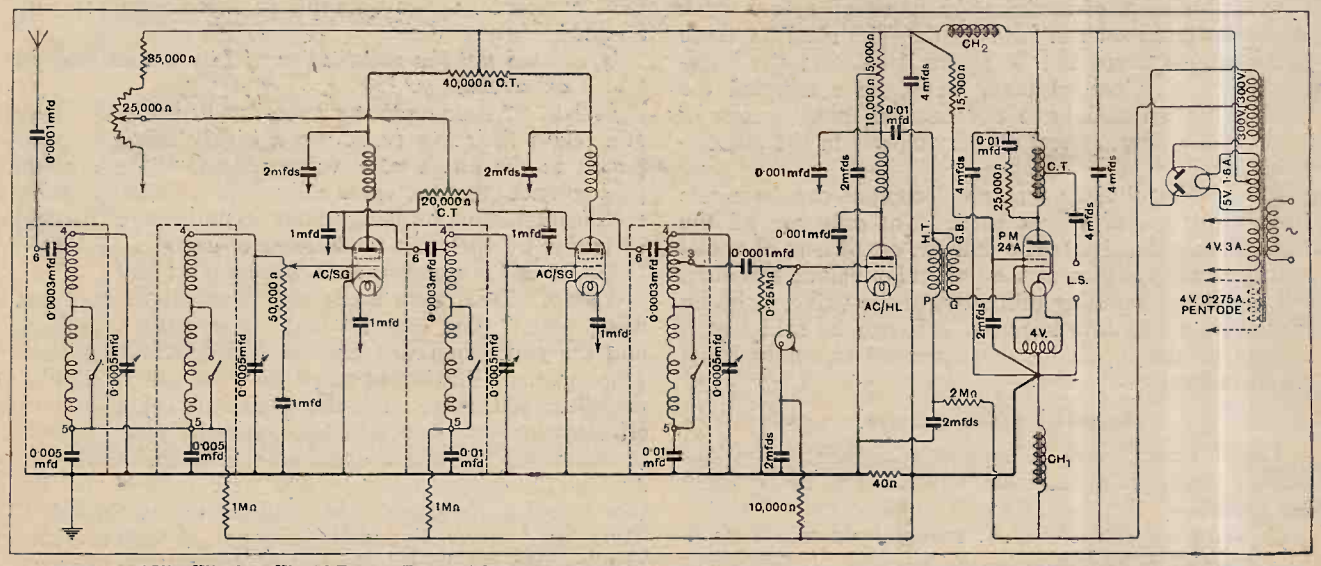
A. Anode and screen current of the two H.F. stages together with the current taken by the screen volts potentiometer totals 25 mA. This current through 40 ohms gives 1 volt.

Q. *Why is decoupling as well as filter feed used in the anode circuit of the detector?*

A. It should be borne in mind that with the value of filter feed resistance normally used a speech voltage is developed across it as well as on the transformer primary.

Q. *May an alternative valve to the power pentode specified be used in the output stage?*

A. One might possibly substitute another type of valve, assuming that it requires the same grid-bias and at that value of bias passes the same anode current. As grid-bias is produced across one of the smoothing chokes it is obvious that a change of valve will probably necessitate a change in the resistance of the smoothing



The circuit of The Wireless World Four. Even with a weak signal rectification occurs in the H.F. stages to a sufficient extent to produce L.F. oscillation unless L.F. decouplings are introduced into the anode circuits. The 1 megohm biasing feed resistances increase the negative bias as soon as the S.G. valves deliver grid current. It is the overloading of S.G. valves and the consequent cross modulation of carriers that gives rise to an apparant flatness of tuning met with when using screen grid H.F. stages without an ærial filter.

Hints on Building The Wireless World Four.—

choke and, incidentally, a change in the load current taken from the rectifier will probably modify the voltages produced right through the set.

Q. *Can the receiver be modified to make use of an existing mains transformer or rectifier?*

A. Yes. If you are prepared to go ahead with the complete redesign of all the voltage regulating circuits.

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From these comments it is to be concluded that the performance of the set is only guaranteed assuming that no departure is made from the circuit given or in the components specified. Among the many completed sets reported to be working very successfully, trouble from faults have in some instances been encountered.

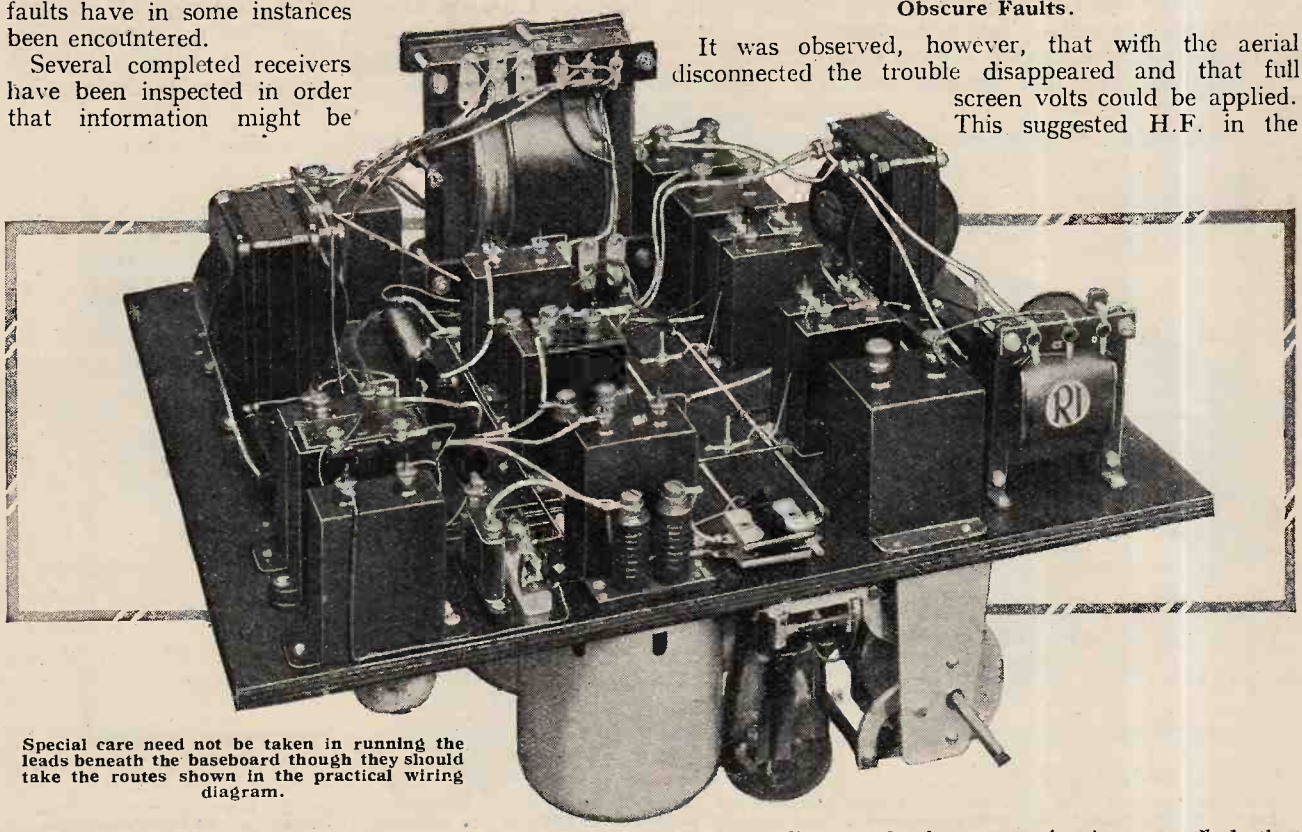
Several completed receivers have been inspected in order that information might be available as to the class of fault commonly eperienced. One receiver examined was reported to be unstable when switched over to long wave. Test revealed that the long-wave reception was poor due to self-oscillation, while the reception of stations on the broadcast band was not up to standard in that self-oscillation took charge long before the correct screen voltage was applied to the valves. Transference of the aerial lead with its 0.0001 mfd. series condenser to the anode lead removed from the second H.F. valve gave good local station reception, tending to indicate that all beyond the detector valve was in order. Likewise, attaching the lead from the fixed aerial condenser to the anode lead of the first H.F. valve showed good stable amplification for the second H.F. stage. Restoring all leads revealed that with more than 20 volts on the screens of the H.F. valves oscillation occurred. A milliammeter interposed in the flexible leads going to anodes of the S.G. valves showed the precisely correct current values of 4 to 4.5 mA., the test being made with the aerial disconnected and the correct screen volts being applied from the potentiometer. There was no need, therefore, to test the various resistances, and it was thought that one of the high-capacity decoupling condensers was not serving correctly as a bypass. A 4 mfd. condenser and a pair of flexible leads was, therefore, connected in turn across every paper dielectric condenser. With the set in the condition of just breaking into oscillation, should a faulty condenser be found or a change be brought about the self-oscillation would be stopped. Still the fault was not traced.

Obscure Faults.

It was observed, however, that with the aerial disconnected the trouble disappeared and that full screen volts could be applied. This suggested H.F. in the L.F. amplier, and close examination revealed that when an additional 0.001 mfd. condenser was connected across the first anode bypass condenser the receiver at once became stable and gave high amplification. Examination of the condenser fitted in the set showed it to have negligible capacity.

Another set examined was suffering from flatness of tuning. This was quickly traced to a contact between the screening cover and the grid voltage decoupling condenser attached to the third coil. There was no bias on the second H.F. valve. One was led to this fault by the fact that the third tuning condenser was out of correct alignment.

Next, a set was examined which was said to be insensitive and to suffer from mains hum. In the course of going over all the usual current and voltage measurements it was noticed that one of the anodes of the rectifying valve was glowing at a dull red heat. This was



Special care need not be taken in running the leads beneath the baseboard though they should take the routes shown in the practical wiring diagram.

Hints on Building The Wireless World Four.—

traced to the fact that on the under side of the valve holder an anode pin was making contact with the tin-plate screen, so that one anode was doing all the work and being overrun. Still the set was not right. The first tuning condenser was slightly out of line when ganging for strongest signal, and there was appreciable hum. The first condition was due to the omission of the 0.0001 mfd. condenser in the aerial lead. Anode currents of the screen grid valves were found to be correct, but short circuiting of the 1 megohm grid leaks gave a big increase in the anode current meter reading. This revealed that the valves were not normally biased, and the small grid current that flowed produced a negative bias by the voltage drop down the 1 megohm resistances. Test across the 40-ohm biasing resistance then showed it to be short-circuited, and after throwing off many leads this was traced to a blob of solder under the pentode valve holder, and one end of its A.C. heated filament was earth connected. Correcting this fault removed the hum and gave the set its right high degree of selectivity.

Another set examined was thought by its builder to not possess the station getting properties claimed. On test it was found that as soon as the screen grid volts reached about 30 self-oscillation occurred. This was due to two modifications. The gramophone pick-up switch was brought to the front panel, so that the grid of the detector valve became coupled with the input stages. This was enough to cause self-oscillation, but in addition the aerial terminal was taken to the back of the set by a lead which took a route through the anode bypass condensers.

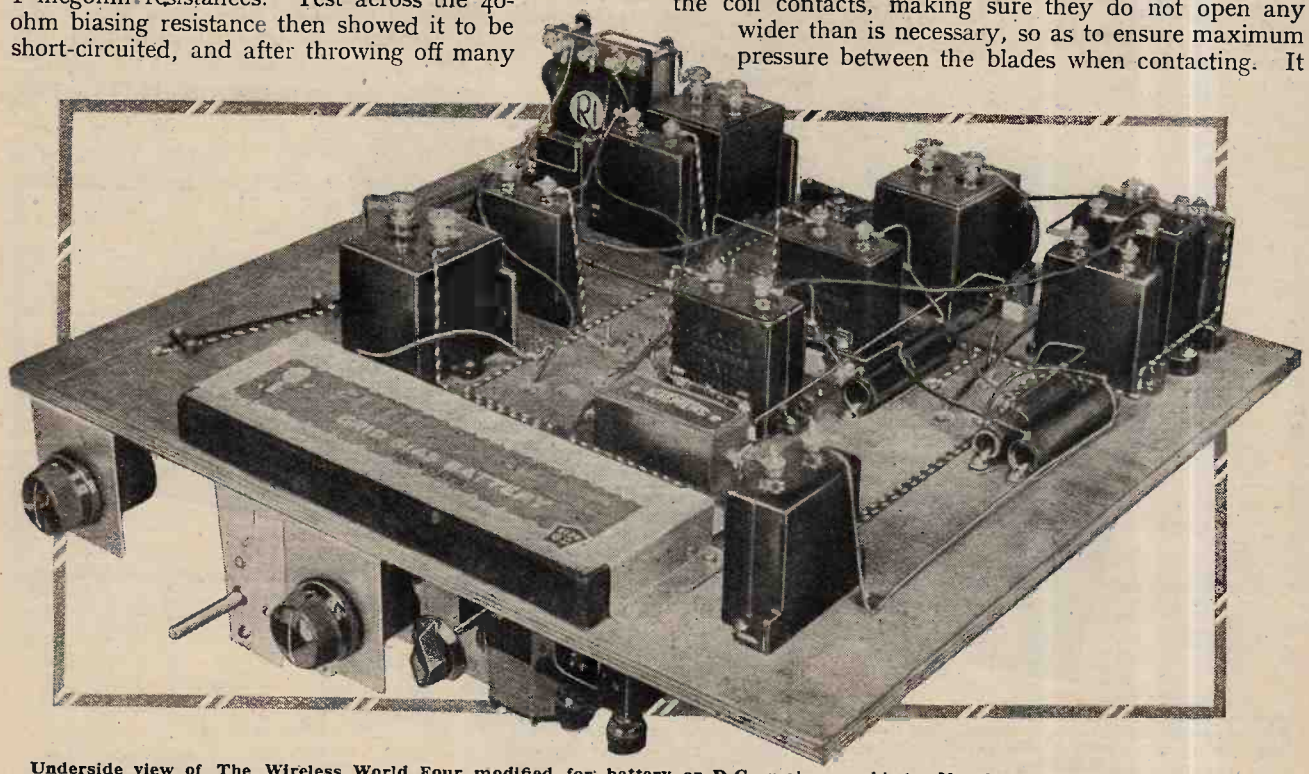
Other sets examined showed the omission of leads, damaged resistances, and, in one case, a damaged H.F. choke. One set had smoothing chokes differing in D.C. resistance from those specified, so that the bias of the output valve was incorrect.

Operating Hints.

In the course of testing the several sets the need for making sure that the ganged switch spindle was earthed became evident. It is therefore advisable to bend up a piece of springy brass and insert it under the end of the rod where it passes out of the front end of the third coil. Alternatively, a piece of flexible wire may be soldered to the spindle and the rotation of the key limited to a right angle. Attention might be given to the coil contacts, making sure they do not open any wider than is necessary, so as to ensure maximum pressure between the blades when contacting. It is advisable, also, to gum a piece of card inside each coil cover in order to prevent contact with the fixed condensers.

When ready to operate the set do not forget that a 0.0001 mfd. condenser is interposed in the aerial lead. In the event of failure the first thing to look to, after checking the wiring, is an earth contact under the valve holders. A piece of insulating cloth under each removes this danger, but care must be taken to effectively earth the caps of the S.G. valve screens.

With signals being received from a few feet of aerial wire, give freedom to the moving plates of the condensers by slightly slacking off the grub screws. Bring each stage in turn to the position of maximum signal, and unless all condensers fall exactly in line it can be concluded that something is not just right. The tuning



Underside view of The Wireless World Four modified for battery or D.C. mains working. No change has been made in the general arrangement of the components above the baseboard so that a set built for use with battery valves may be readily changed over for use with A.C. supply.

Hints on Building The Wireless World Four.—

range is from 180 to 555 metres, so that Budapest is just at the top of the scale with Vienna a few divisions farther back. Every set tested gave these two stations indoors in London at full loud speaker strength on 10 feet of aerial wire and a short earth lead.

The output from the PM24A through the step down choke was found to be 1.6 watts into a 8,000 ohm non-inductive load before grid current occurred. The valve runs rather hot but shows no deterioration after considerable use. Cooler running on reduced output results from the substitution of a 30,000 ohm resistance in its screen lead in place of the 15,000 ohm resistance specified. It is most important that the loud speaker is not removed from circuit when the set is switched on and tuned to a signal. High momentary voltages will endanger both pentode and choke.

For distant station reception turn the volume control to the top of the scale and advance the screen volts control to the point of maximum sensitiveness. In this condition the second H.F. valve has been found to overload just before the pentode and the passage of grid current through its 1 megohm feed resistance prevents, by increasing the bias, the grid current reaching a value of much over one microampere. By means of the centre tapped output choke the pentode impedance is adjusted to suit the average high-resistance loud speaker, whether moving iron or moving coil. The output conditions are approximately the same as a filter feed in the anode circuit of a triode power output valve, such as a P.625. Excellent results can be obtained with a moving coil loud speaker, and so-called special pentode coil windings are unnecessary. The working load best suited to the pentode is of the order of 8,000 ohms, and this is brought down to 2,000/4,000 ohms by an output choke tapped at, or just above, the centre.

There is no better endorsement of the overall performance of the set than the statement of a reader in South London that he can pick up forty-seven transmissions by slowly following around the dial on the two wave ranges. Many readers have suggested that a battery version of this receiver should be produced. This has been done, and as in the original, no parts need to be home constructed. The design is such that additional apparatus can later be fitted for converting the set for all A.C. mains working, while a cabinet is now available converting the set to a table model.

(Constructional details will appear next week.)

CLUB NEWS.

"Wireless World Four" Demonstrated.

Mr. F. H. Haynes, of *The Wireless World*, gave a detailed description at the Wembley Radio Society of all the new points introduced into the "'Wireless World' Four," dealing with all the problems involved in the design of long-range all-mains sets.

Following his very excellent description of the developments which led up to the production of this set, the lecturer switched on the current and demonstrated its capabilities. It was really amazing to hear the different stations apparently falling in one after the other. The slightest movement of the dial changed the set from one station to another.

The lecturer's talk was very closely followed and many interesting questions were asked, one touching the important question of quality; thereupon the untiring secretary of the society, Mr. Comben, produced one of the latest moving-coil speakers, which was connected up to the receiver. The quality of the reception was all that could be desired.

Hon. Secretary, Mr. H. E. Comben, B.Sc., A.M.I.C.E., 24, Park Lane, Wembley.

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L.F. Amplification.

Mr. A. W. Cloude, B.Sc., Ph.D., one of the experimental and designing engineers from the laboratory of the Standard Telephones and Cables, Ltd., lectured and demonstrated to members of the Grimsby and District Radio Society at a recent meeting, the subject being "Distortionless L.F. Amplification." The lecturer touched on important facts that it was necessary for the experimenter to know before he could hope for success.

Hon. Secretary, Mr. W. Markham, 104, Torrington Street, Grimsby.

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A Pick-up Demonstration.

Mr. W. D. Oliphant, B.Sc., of Messrs. Burndept, Ltd., lectured on the "Theory, Design and Operation of Pick-ups," at a recent meeting of the North Middlesex Radio Society.

With the help of lantern slides and a dissected specimen of a Burndept needle-armature pick-up, Mr. Oliphant dealt very lucidly with a highly technical subject.

After the lecture a very interesting demonstration was given by Mr. Ridley, also of Messrs. Burndept, who has been largely responsible for the design of the instrument demonstrated. Records of various kinds were played and reproduced very realistically on a large moving-coil loud speaker. The effect of a "scratch filter" in getting rid of surface scratch was also demonstrated.

Hon. Secretary, Mr. E. H. Laister, "Windflowers," Church Hill, N.21.

A Rotating Radio Beacon.

Dr. R. L. Smith-Rose, of the National Physical Laboratory, lectured on November 25th before the Northampton and District Radio Society in the Lecture Hall, Free Library, Northampton, on the subject of "Direction Finding by Radio."

The lecturer was chiefly concerned with the Holfordness rotating beacon. Signals from the beacon are received on two sets of apparatus, and a bearing is obtained by one of the special stop-watches designed for this use.

The weekly meetings of the Society are held at "Handicrafts Tea Rooms," St. Giles Square, Northampton, on Tuesday evenings at 8 p.m. The Secretary is Mr. T. W. Rolfe, 17, Beaconsfield Terrace, Northampton.

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The Year in Birmingham.

At the third annual general meeting of Slade Radio (Birmingham) good progress and a large increase in membership were reported. Forty-nine well-attended meetings have been held during the year, and at each there has been either a lecture or a demonstration; a record of which the Society is justly proud. Besides this there have been D.F. tests, outings to places of interest, and two whist drives and dances.

Anyone interested in wireless may be certain of a very hearty welcome at any of the meetings, which are held every Thursday at 8.15 p.m.

Full details may be obtained on application to the Hon. Secretary at 110, Hillaries Road, Gravelly Hill, Birmingham.

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Working from the Mains.

"All-Mains Working" was the title of a lecture given by Mr. F. Youle, B.Sc., of the Marconiphone Co., Ltd., to members of the Bec Radio Society, Bec School, Beechcroft Road, Balham, S.W.17, on Tuesday, November 25th.

The lecturer supplied some interesting facts relative to the design of eliminators, and particularly in connection with smoothing circuits. The latter included reference to the "tuned-choke" method described recently in *The Wireless World*. Automatic Grid Bias was treated in detail by Mr. Youle, who displayed a number of lantern slides dealing with the chief points.

At the conclusion of the lecture a "Marconiphone" all-mains two-stage amplifier utilising an L.S.6a valve in the output circuit was demonstrated very successfully in conjunction with a moving-coil speaker and gramophone records.

Hon. Secretary, Mr. A. L. Odell, 9, Westway, Grand Drive, Raynes Park, S.W.20.

Points About Pick-ups.

On Wednesday, November 26th, Mr. Oliphant, of Messrs. Burndept, Ltd., gave a lantern lecture and demonstration before the Tottenham Wireless Society on "The Theory, Design and Correct Operation of Gramophone Pick-ups." Mr. Oliphant dealt with the weight of the pick-up, correct tracking, electrical and mechanical resonances.

Hon. Secretary, Mr. W. B. Bodemeaid, 29, Pendennis Road, N.17.

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A Refractory Valve.

By its refusal to function, the heater of an A.C. valve provided a few minutes of embarrassment at a recent meeting of the South Croydon and District Radio Society, at which Mr. Remington, the designer, introduced the Club's new all-mains set. Actually the members benefited by the lapse, for they were able to follow the process of elimination by which the trouble was finally traced.

Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, S. Croydon.

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For Cambridge Enthusiasts.

The Cambridge and District Radio Society now meets regularly on Tuesdays at 7.30 p.m. at "The Hermitage," Silver Street.

New members are heartily welcomed.

Hon. Secretary, Mr. A. E. Porter, 19, Trafalgar Street.

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Meetings Twice a Week.

The Kentish Town and District Radio Society is holding regularly meetings on Tuesday and Friday of each week. Full particulars can be obtained from the Hon. Secretary, Mr. C. Townsend, 14, Hamilton Street, Camden Town, N.W.1.

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Metal Rectifiers on the Screen.

On Wednesday, November 19th, a group of Manchester wireless enthusiasts, including members of the Radio Experimental Society, Radio Scientific Society, The Stretford and District Radio Society, South Manchester Radio Society, and visitors, greatly enjoyed a lecture which was given by the Westinghouse Company on the subject of Metal Rectifiers. By means of a fine set of lantern slides and roll film, a most interesting description of the whole process of rectification was explained and its many applications illustrated.

Particulars of the Radio Experimental Society can be obtained from the Hon. Secretary, Mr. R. M. Kay, 58, Daisy Bank Road, Victoria Park, Manchester.

NEON MUSICAL OSCILLATOR

A New Electro-musical Instrument and a New Theory.

By R. RAVEN HART.

AMONG recent developments in the field of electrical music none is probably more interesting than the invention of Dr. Trautwein, of the Radio Research Section at the Berlin Akademische Hochschüle für Musik. Not only is it sufficiently interesting musically to have induced such a composer as Hindemith to write specially for it, but it involves a new theory of acoustics with reference to the tone-quality of instruments in general.

This theory may be briefly stated as follows: The "quality" of the majority of musical instruments is due principally to the presence of one or more "tone-formers" which are heard simultaneously with the fundamental. These are damped oscillations of a definite frequency, which is always higher than that of the fundamental, and which is not necessarily a multiple of it; in fact, for a considerable range of variation of the fundamental frequency, that of the "tone-former" remains unaltered. They are produced in general by momentary variations of volume occurring at least once in each period of the fundamental oscillation, and they die out before the end of each fundamental period or are wiped out by the beginning of the following one.

What Tone-formers Are.

This statement is a free translation of that given in Dr. Trautwein's book, "Elektrische Musik," published by the Weidmannsche Buchhandlung, of Berlin. The term "tone-former" has been adopted tentatively to translate "Hallformant," which in its turn is based on the term "Formant," used by Professor Herrmann, of Königsberg, in his theory of speech sounds; Dr. Trautwein's theory is an extension of this to cover musical sounds also, or one may even say that Professor Herrmann's theory is a special case of Dr. Trautwein's.

It should be noted that not all musical tone-qualities are caused in this way; some (that of the flute especially) appear to contain no "tone-formers," and can be explained by the older theory of overtones; and others need yet a third explanation, that of "modulation-formers," recently discussed by Dr. Trautwein at Königsberg, but (I believe) not yet available in a published form. Nevertheless, the great majority of musical "qualities" are traceable to the presence of one or more "tone-formers," together with the fundamental frequency.

It is, of course, easy to see how the slight variations in volume above referred to arise; one has only to think of the slipping hold of a violin-bow on the strings, the vibration of a clarinet reed, etc.

If the theory stopped here it would be of interest but might fail to convince the layman; the author has, however, developed electrical circuits which seem to provide a perfect demonstration of the theory, and which in any case give extremely interesting musical results. More especially, while retaining the advantages of previous instruments (continuous control of pitch so that any interval can be produced, quarter, eighth tones, etc., continuous control of volume, unlimited duration of tone, etc.), this new instrument allows of the quality being instantaneously and continuously varied, so that one is not restricted to certain "qualities" fixed beforehand like organ-stops, but has a literally infinite choice.

Fig. 1 shows one of these circuits, which is very easy to build though not practical for playing; the writer must, however, confess that it is fascinating for playing *with*, to the extent of holding up all other work for several days! Here a neon lamp 1 is connected in circuit with a variable resistance of the order of one megohm and with a condenser of some thousand

Neon Musical Oscillator.—

micromicrofarads. The impulses from the circuit are amplified by the triode 4 and passed to the circuit S, the natural frequency of which is between 400 and 4,000 cycles, and whose damping can be reduced by the reaction condenser 5 or increased by the resistance 7. The resistance 6, of about one megohm, serves to keep down the coupling between S and the neon lamp circuit. This is an important refinement.

Now, if the neon lamp circuit be set to a frequency below the audible limit a series of tones will be heard, rather like isolated bell-notes or those of a xylophone, and any change in the condenser of the circuit S will change the pitch of the "bell" or xylophone-bar; the pitch heard is that of the circuit S. If, however, the frequency of the neon lamp circuit be increased (by decreasing the capacity 3 or the resistance 2) so as to reach an audible tone, the curious effect is produced that the note previously heard (from S) disappears completely, and the *new* note (from the neon lamp) is alone heard, as a tone of definite quality. Further, this quality remains practically unchanged for changes of pitch (neon lamp circuit) so long as the frequency of S (the "tone-former") remains unchanged, but changes strikingly when the condenser in S is varied; for example, a low-frequency tone-former suggests a bassoon, a certain higher frequency a clarinet, another higher still a trumpet, and so on, the pitch of the note (neon lamp circuit) remaining unchanged.

The damping of S affects the quality differently, slight damping giving shrill and rather acid effects, while

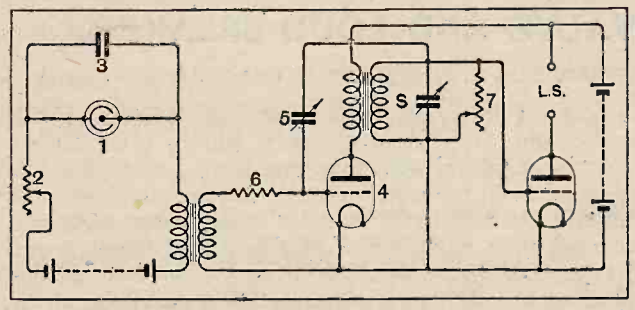


Fig. 1.—An experimental arrangement in which changes of frequency can be made in the Neon circuit and in the circuit marked S.

heavier damping gives a more rounded note; in this connection, Dr. Trautwein has a very interesting excursion on the relative qualities of good and bad violins and the possibility of explaining them by similar damping effects in the "tone-formers" produced.

It must be realised that it is only possible here to give the main points of the theory; many practical details, and especially many striking suggestions, must be omitted or touched on merely in passing—among such is a note on loud speaker resonances, to the effect that their detrimental effect is less in exaggerating certain notes than in tending to produce "tone-formers," and that the beneficial effect of parallel capacity is in the absorption of the impulses giving rise to these. Or again, on the effect not only on pitch but on quality of running gramophone discs at an incorrect speed, since not only the fundamentals but the tone-formers are altered in frequency. Or again, on the imitation of animal sounds and human speech (vowels) with the above circuit, and on the possibility that the power of

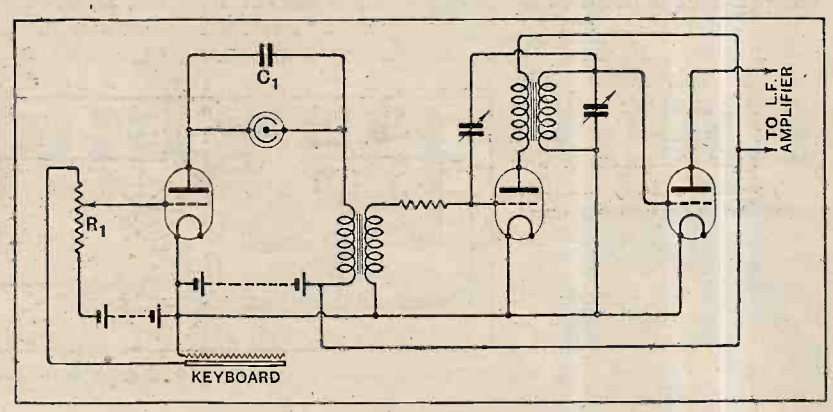


Fig. 2.—A more fully developed scheme.

speech was developed when the ability to hold the tone-former frequency steady appeared.

Another experiment with the simple circuit of Fig. 1 is to keep the fundamental frequency steady and alter the tone-former frequency slowly by means of the condenser in the circuit S. So long as this is being changed the ear can distinctly hear the *two* notes and follow the change in pitch of the tone-former, but as soon as this is left steady the ear loses this upper tone and instead receives the "quality" effect. (So Dr. Trautwein states; personally, I have found that the effect of the two notes may persist for an appreciable time after the tone-former is left steady, especially if the attention is concentrated on it. The moment of its disappearance is quite definite and it seems to go with a jump; the nearest parallel is the optical illusion of the black and white cubes which suddenly change from projecting corners to receding ones. No doubt the personal element enters very largely here.) On the other hand, step-by-step changes of the tone-former frequency give the effect of various instruments playing in turn. If both the pitch and the tone-former frequencies be altered simultaneously, the former step-by-step and the latter continuously, what Dr. Trautwein calls a "peculiar" effect is produced. After hearing it one realises that no word exists strong enough to describe it, so "peculiar" may serve as well as any other; his suggestion that it may be usable in music opens up a perspective of fresh possibilities, or of fresh horrors, according to one's musical tastes.

An Ingenious Volume Control.

Fig. 2 shows, in a simplified form, a more fully developed instrument; the complete diagram is in the book quoted.

As a practical point it may be mentioned that suitable neon lamps are somewhat difficult to find; as a rule they are constructed so that the illumination and

Neon Musical Oscillator.—

extinction voltages are well apart, whereas for our purposes we want them close together. Those made for lightning protection are often suitable; the writer used an American make of this type (Dr. Trautwein has been kind enough to inform me that neon lamps made by Philips are suitable.

It should be noted that in the apparatus of Fig. 2 the actual playing is not done by means of the resistance R_1 or the condenser C_1, but by pressing down the stretched resistance-wire of the "keyboard" to touch the bar below it, this altering the internal resistance of the triode; one reason of this is so that the distances on the "key-board" may be the same for a given interval throughout the range—were the wire used directly, the fingering at one end would be very crowded, unless a special tapered resistance were used. It will also be noted that when the wire is not depressed the full grid-battery voltage is applied, thus completely blocking the valve; there is thus not the difficulty here in avoiding legato effects that occurs with some earlier instruments, though, of course, such effects can be produced when desired by sliding the finger along the wire while keeping it depressed.

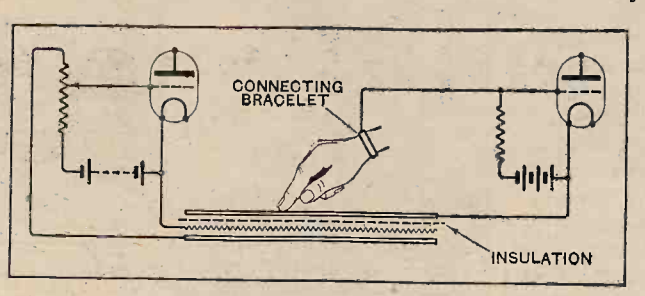


Fig. 3.—Volume control by the resistance of the human body.

Volume is controlled in the usual way, in the amplifier that follows the circuit of Fig. 2. Several interesting methods for using this control when playing are discussed, of which perhaps the most useful is that in which the finger does not directly touch the "keyboard" wire, but presses it down through another metal band stretched parallel to and in mechanical contact with it, but electrically isolated. In this case the resistance of the human body is used to control the volume, according to the amount of pressure exerted by the finger on the metal band (Fig. 3), this in turn acting on the grid potential of the last valve of Fig. 2. In this way one finger suffices, and it is thus possible to play more than one note at a time by having various instruments, each with its own "keyboard" and putting these close to one another.

The control of quality while playing can be made by having a multiplicity of fixed condensers in the circuit S, controlled by contacts like organ stops; but a more interesting method is to make it possible to displace the "key-board" horizontally, towards or away from the player, making this movement actuate the variable condenser in S.

The first public demonstration of the "Trautonium," as the instrument is called, took place at the Hochschüle für Musik, Berlin, on November 18th, Dr. Trautwein lecturing and Hindemith, Rudolph Schmidt and Oskar Sala playing solos and trios. The last-named (the most skilled Trautonium player of to-day) also demonstrated the possibilities of the instrument. On November 30th a broadcast from the Berlin station was arranged, the Trautonium playing direct into the modulator circuit.

THE PROBLEM OF MATCHING VALVE AND LOUD SPEAKER.

Choosing the Correct Impedance.

WHEN calculating the correct value of loud speaker impedance to use in connection with a given output valve or valves, it must not be forgotten that if valves are connected in parallel the resultant A.C. resistance will be equal to the A.C. resistance of any one of them divided by the number of valves used, it being assumed, of course, that all valves have the same characteristics. When valves are connected in push-pull, however, their individual values of A.C. resistance are additive. An endeavour should always be made to make the loud speaker impedance approximately double the A.C. resistance figure for the output valve or valves. This statement requires qualifying since, of course, the impedance of a loud speaker varies with frequency. The frequency which should be taken in connection with the statement made above should be that of middle C, which is 256 cycles per second. It is necessary, therefore, to ascertain the loud speaker impedance at this frequency or at the nearest round figure to this frequency. By thus "matching" the loud speaker impedance, maximum power transference from the output valve to loud speaker will take place at this frequency, and it will be found that, in the case of nearly all moving-iron loud speakers, if this is done the most pleasing results will be obtained.

In cases where more than one loud speaker is to be operated from the same output valve or valves, it must not be forgotten that if the loud speakers are connected in series their impedances must be added together and the resultant figure must be taken for the basis of our calculations. If they are connected in parallel and are all of the same value it is necessary to divide the impedance of one of them by the number of loud speakers employed, as in the case of output valves previously discussed.

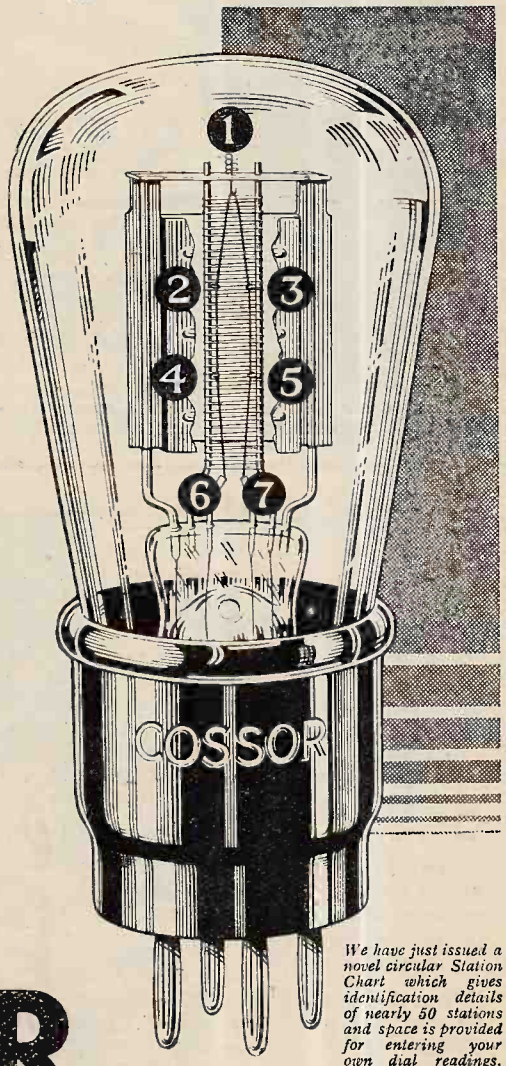
Transformer Ratio.

In cases where the impedance of the loud speaker is very low, or in cases where a large number of parallel loud speakers are used, it is necessary to use a step-down transformer of suitable type. Provided that the correct ratio is chosen the result is as though the impedance of the loud speaker had been actually increased to the required value. A transformer will have the effect of "raising" the loud speaker impedance by an amount which is equal to the square of the ratio.

Microphonic noises

definitely eliminated by

Seven point suspension



THE cause of microphonic noises in a Receiving Set is generally to be found in a faulty Detector Valve. Usually it is due to filament vibration. The new Cossor Detector Valve (210 Det.) has been specially designed to overcome this fault. Filament vibration is rendered impossible by a new method of seven point suspension. The diagram shows the four insulated hooks which secure the filament in position and damp out any tendency to vibration. The use of this "steep slope" Cossor Detector Valve not only eliminates microphonic noises, but ensures great volume with exceptional purity of tone.

The New Cossor 210 DET., 2 volts, ·1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1·15 m.a./v. Normal working Anode Voltage 90-150. *Price* 8/6

THE NEW

COSSOR

DETECTOR VALVE

We have just issued a novel circular Station Chart which gives identification details of nearly 50 stations and space is provided for entering your own dial readings. Price 2d. each, they are obtainable from any Wireless Shop. In case of difficulty write us, enclose 2d. stamp and head your letter "Station Chart W.W."

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The Six-Sixty A.C. All Mains Conversion Equipment

Supplies H.T., L.T. and Grid Bias at a fraction of the cost of batteries—takes no more room. Power Unit only £6 : 6 : 0. Complete Conversion Equipment from £8 : 5 : 0, includes Power Unit, 5/4 pin Valve-Holder Adaptors and a set of SIX-SIXTY A.C. VALVES to suit your circuit, giving added range and a large distortionless output.

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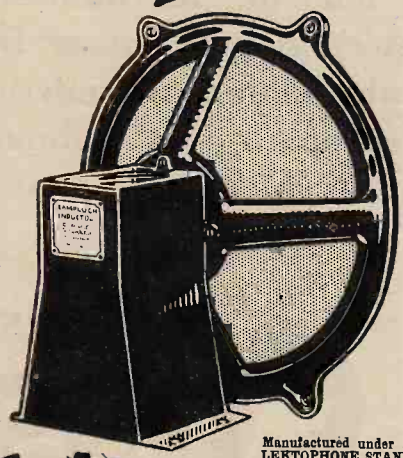

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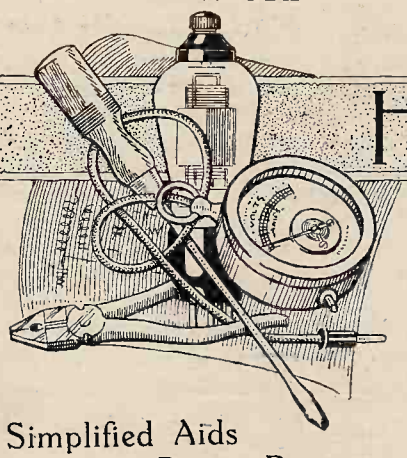


Simplified Aids to Better Reception.

MAINTAINING A BALANCE.

In the "Hints and Tips" section of *The Wireless World* of November 26th, attention was called to the danger of introducing short circuits across grid bias cells in cases where a ganged condenser—with metallically connected rotors—is used in conjunction with battery-operated valves. The conclusion was reached that, in constructing an up-to-date receiver embodying an input filter, it is often as well to adopt grid circuit arrangements that have proved successful in mains-driven sets.

With reference to Fig. 3 of that paragraph, it may have been noticed that a fixed condenser was shown as being connected in the tuned detector grid circuit. This condenser should have the same capacity as C_m (which is common to the other two oscillatory circuits), and it is inserted merely to ensure that the incidental capacities across each inductance may be as nearly equal as possible. It is only by taking precautions of this sort that a really successful "single knob" system of tuning may be evolved.

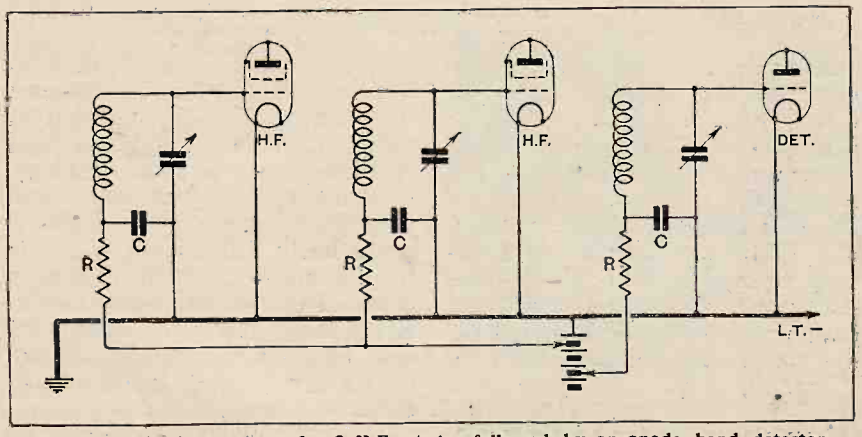


Fig. 1.—Grid bias system for 2 H.F. stages followed by an anode bend detector. The condenser rotors may be earthed, and the first by-pass condenser (C) may be the coupling condenser of a filter. Decoupling resistances are marked R.

When balancing condensers must of necessity be inserted in an H.F. intervalve circuit, it is as well to make these otherwise profitless components do as much useful work as possible. In a battery set they may be used as part of the grid bias feed system, as shown in the accompanying diagram, Fig. 1. The appropriate connections for an anode bend detector are indicated in this diagram; when grid rectification is employed, there is, of course, no difficulty in obtaining the correct operating conditions, as the grid is insulated by its series condenser, and any desired operating potential may be impressed through the leak.

oooo

SCREENS AND COILS.

It is now generally agreed that there was at one time a tendency to over-estimate the minimum spacing advisable between coils and screens, and that the arbitrary limit of 1½in. then fixed need only be insisted upon when highly-efficient inductances of large physical dimensions are employed in circuits where no efforts are spared to minimise incidental losses. But it should not be forgotten that the close proximity of metal work has another effect besides that of introducing resistance; it also reduces the inductance value of the coil. In cases where insufficient clearances are allowed, a winding, in conjunction with the value of condenser capacity for which it is intended, may be found inadequate for covering the normal broadcast waveband unless a number of turns be added to it.

oooo

SCREENING GRID VOLTAGE.

Many mains-driven receivers are provided with a critical adjustment for regulating voltage supply to the screening grid of the high-frequency amplifying valve, or else there is a similar control in the eliminator from which the receiver is fed. When loud signals are being received, or when the H.F. valve is in an unnaturally sensitive condition, due to the fact that it is not very far from the point of self-oscillation, it is none too easy to make the precise adjustment giving maximum real magnification. It is recommended that this operation should be carried out when listening to a strong signal made artificially weak by detuning grid and plate circuits. Under these conditions, without any disturbing factors, it is easy to determine the best setting.

oooo

POWER AND LIGHTING CIRCUITS.

It cannot always be assumed that the voltage of domestic lighting and power circuits is identical, and, before transferring the connections of a mains-driven receiver from one to the other, it is wise to verify this point, either by examining the meters or by enquiring at the local supply company's office.

A case recently came to the writer's knowledge where current for lighting was supplied at 110 volts, and for power at 220 volts; the power transformer of the receiver was designed for the low pressure, and considerable harm was done by connecting it inadvertently to a high-voltage power point.

"GOOD" COILS AND SELECTIVITY.

Attention has recently been drawn to the fact that the insertion of a coil of exceptionally low H.F. resistance in the anode circuit of an H.F. valve may have an effect on selectivity which is exactly opposite to that to be expected. But although interference may actually be increased by using a tuned circuit of abnormally high efficiency, it must be remembered that this effect is likely to be evident only when the total dynamic resistance of the tuned circuit is inserted in series with the H.F. valve anode. A good coil may still be used with advantage, from the point of view of selectivity, if it is suitably connected as a tuned grid inductance or as an H.F. transformer secondary. To prevent the transference of an unduly high proportion of the total of dynamic resistance, the coupling must be loosened. This can be arranged in the case of the tuned grid circuit by "tapping down" the anode connection to a point remote from the high-potential end of the coil. In dealing with a transformer, the corresponding procedure is to remove primary turns.

It is inevitable that a reduction in coupling below the value necessary to give stability and adequate selectivity under conditions where very small inputs are to be dealt with will be accompanied by a falling-off in amplification; by carrying this matter to its logical conclusion, one sees another argument in favour of obtaining as much selectivity as is possible before the first valve—in other words, of adopting the principle of pre-selection.

oooo

LEAKAGE AND "HUM."

It has been stated in these notes that "hum" may be produced in an A.C. mains driven receiver if an excessively high capacity exists between the high-tension secondary and the output filament winding of the power transformer. Some readers seem to be uncertain as to how this trouble is brought about; it is hoped that the skeleton diagram given in Fig. 2 will make the matter clear to them. This circuit shows the essentials of an output stage of the type in question, and the stray capacity between the transformer windings which may be responsible for the trouble is indicated in dotted lines. It will be seen that voltages developed between the end of the H.T. winding and the centre point are transferred *via* the capacity in question across the grid bias resistance R_1, and so to the grid circuit of the output valve. These voltages may be sufficiently great to cause hum in spite of the presence of the usual decoupling resistance R, with its by-pass condenser C.

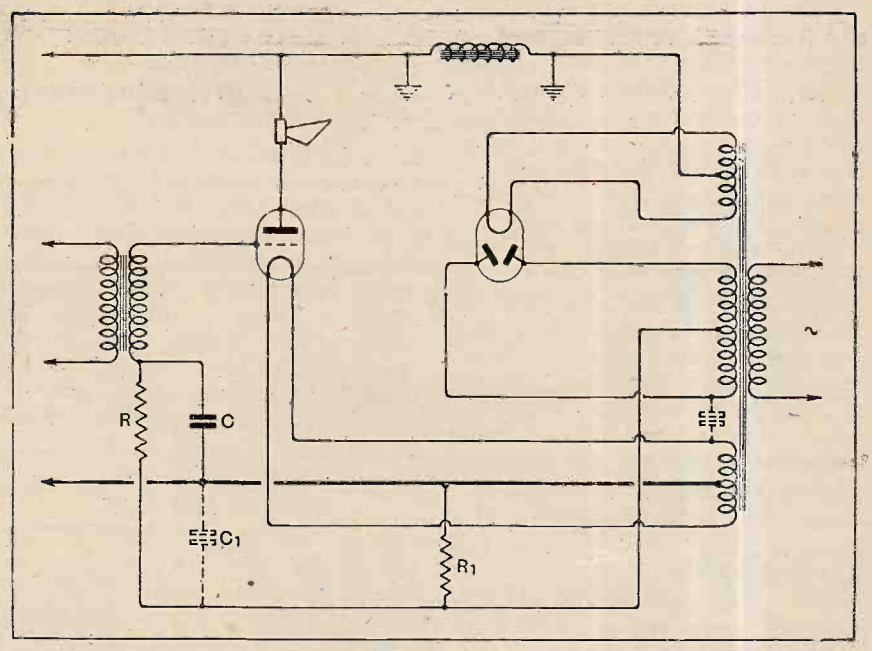


Fig. 2.—How A.C. voltages may be transferred to an output valve grid circuit through capacity leakages between power transformer windings.

As a rule, the trouble may be overcome by connecting a large condenser (of 2 or 4 mfds.) across the bias resistance as shown in the diagram, where this extra condenser is marked C_1. Further, to ensure an adequate reduction of A.C. voltage, it may be necessary to fit a decoupling resistance R of higher value than usual; as a rule this will not have any harmful effect as regards the general performance of the receiver.

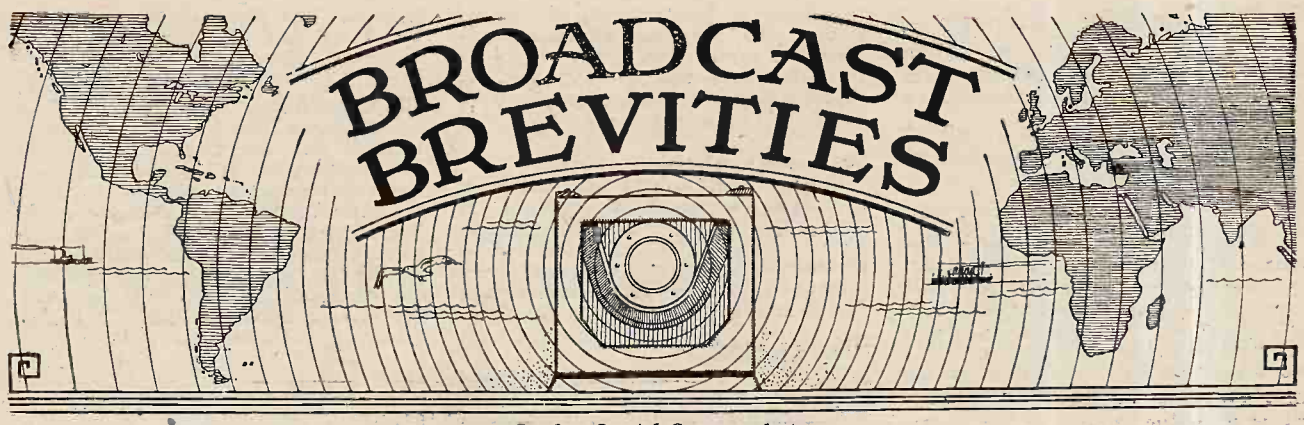
oooo

VARIABLY COUPLED FILTERS.

For operation by the non-technical listener, a fixed coupling between the two elements of a band-pass filter is highly desirable, but for the well-informed wireless user, who is well capable of making adjustments intelligently, it is possible to make out a good case for variable coupling. When provision is made for changing the width of the resonance curve it is possible to adapt the receiver to the needs of the moment, and, by sacrificing some of the higher modulation frequencies, to receive stations that might otherwise be interfered with to an unnecessary extent.

It is well known that the use of a filter circuit involves an appreciable—but, fortunately, not very serious—sacrifice of signal voltage. A further advantage of variable coupling is that it enables the filter to be so adjusted that the optimum transference of energy between its circuits is produced, and thus losses of intensity may be largely avoided.

Of the various possible methods of linkage that are available, it seems likely that the use of a very small condenser between the high-potential end of the tuned circuits is the most convenient when variable coupling is desired. A condenser with a very low minimum value—not more than 2 or 3 micro-microfarads—should be chosen. Its maximum capacity need not exceed some 20 micro-microfarads as a general rule. Very special attention should be paid to screening when this method is employed, and electrostatic coupling between the tuning condenser units should be specially avoided.



By Our Special Correspondent.

Tests for Gift Sets.—Christmas Day Gramophone Recital.—Grand Good Night.—Regional Problems.—Television Transmissions to Continue.—The Interval Signal.

Yuletide Test Transmissions.

For the first time in the history of the Christmas festival, test transmissions are to take place on December 25th next for the special benefit of the lucky people who have been given wireless sets as Christmas presents.

From 12 noon to 3 p.m. on Christmas Day a continuous gramophone recital will be given at the Midland Regional station. To enable listeners to submit their new receivers to the acid test every type of record will be broadcast.

oooo

Special Concession.

The "unfortunates" who must make the most of old sets will also be allowed to listen.

oooo

No District Visiting.

There is no truth in the rumour that the Postmaster-General and his assistants will pay house-to-house visits on Christmas Day.

oooo

America to Relay Christmas Service.

The short studio service on Christmas evening which is to be conducted by Rev. J. A Mayo, Rector of Whitechapel, will be relayed by the Columbia Broadcasting Company of America.

Mr. Mayo was the first broadcasting parson in Great Britain, his first broadcast having taken place from the studio in Marconi House at Christmas, 1922.

oooo

No News.

Unless some event of national importance occurs, there will be no news bulletins broadcast on Christmas Day.

Dance music will be broadcast until 1 a.m. on Boxing Day.

oooo

Good Night!

Mr. J. C. Stobart, whose "Grand Good Night" has become an annual feature on New Year's Eve, has undertaken to prepare another salutation to the world for delivery on December 31st.

Listeners will also be taken on an imaginary trip round the globe.

oooo

"Other Matters."

No giant intellect seems to have lighted on and analysed a certain statement made in Parliament by Mr. Lees-Smith, the Postmaster-General, on December 1st. In reply to questions regarding the proposed subsidy for opera, the P.M.G. said it was probable that the supplementary agreement between the B.B.C. and the Post Office would deal with other matters besides grand opera.

oooo

Possibilities.

No one bothered to ask for further details as to the connotation of the term "other matters"; whether it referred to such diverse items as the proposed National Theatre or to television, or whether it was merely a synonym for "anything under the sun, barring opera."

oooo

A Special Grant?

Actually I understand that the P.M.G. had in mind an application which the B.B.C. has made for a special grant of £200,000 for the development of the Regional Scheme.

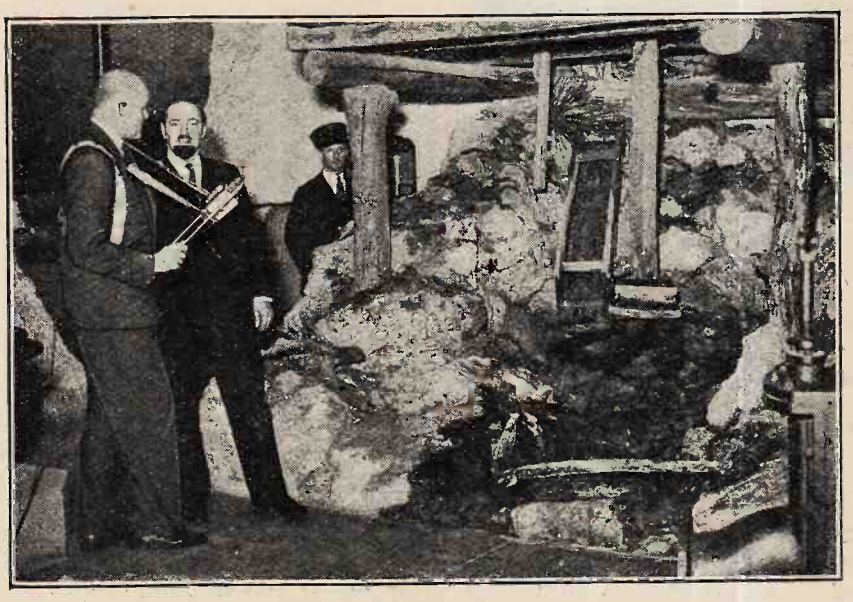
With engaging frankness, the Corporation has already explained in its Year Book that the time is approaching when its revenue and capital expenditure are bound to exceed greatly its present financial resources. Some of the existing limitations on the Corporation's resources must be overcome, it is pleaded, if progress is not to be hindered.

oooo

No Immediate Financial Strain.

If the £200,000 can be obtained, the B.B.C. feels that the Regional Scheme will be assured. I understand that financial considerations are not impeding the work at the present moment.

Northern Regional should be operating a twin-wave service by next March, while work on the Scottish Regional may be expected to begin shortly.



HOW THEY DO IT IN MUNICH. The "microphone reporter" giving a running commentary on his visit to the famous Deutsches Museum in Munich. He is seen discussing an exhibit with the curator.

The Scottish Regional.

The difficulties regarding the Falkirk site relate to the purchase terms, but observers would not be surprised if the negotiations were concluded within a week or two.

Tenders for the preliminary constructional work have already been obtained.

oooo

Television in the New Year.

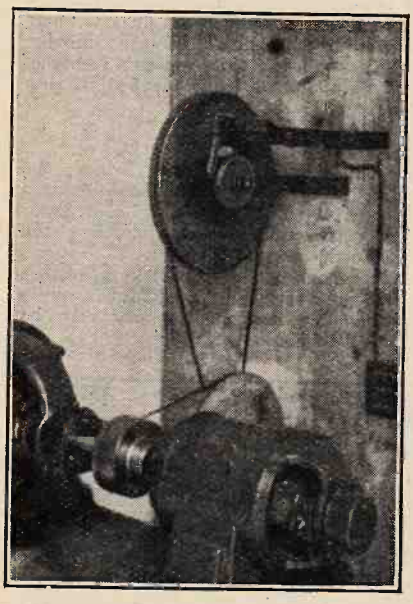
Tales have been going the rounds that the B.B.C. is casting its eye on foreign systems of television, but I understand that they are true only to the extent that Savoy Hill endeavours to keep informed as to all developments affecting broadcasting, whether British or foreign.

There is not the slightest suggestion that the Baird experiments are to be superseded.

oooo

Baird Tests to Continue.

"The Baird transmissions are going on," said a B.B.C. official, "and, subject to its prior duty as regards the broadcasting services, the B.B.C. will do its best to help along British television. Arrangements for the Baird television tests during the New Year are already under discussion?"



THE INTERVAL SIGNAL. Interest has been aroused by the B.B.C.'s decision to use an interval signal. The photograph shows the apparatus used for the famous "cuckoo" call at Ljubljana, Yugoslavia.

The Interval Signal.

Clouds of mystery are beginning to enwrap the proposed interval signal. No ticking apparatus, I am told, has yet arrived at Savoy Hill, but this in itself is no guarantee that listeners may not be startled by ticks in the very near future.

oooo

Listening "On Tick."

Anything in the nature of a distinctive interval signal is repugnant to the B.B.C. It seems that, like the authorities at the Rome broadcasting station, Savoy Hill can conceive of no interval signal thoroughly in keeping with its dignity. Cuckoo calls, gongs and rattles are suggestive of the nursery. There are even fears, I believe, that the clock tick will vulgarly suggest that some listeners have not paid their licence fee.

oooo

The Giants Capitulate.

Broadcasting has made two conquests in the last few days by the inclusion in the programmes of those two great singers, Peter Dawson and John McCormack. How many listeners hearing these two realised that neither had broadcast before?

oooo

Rivalry in Scotland.

At last the B.B.C. has recognised Edinburgh as the capital of Scotland. The opening of the Scottish "Broadcasting House" on November 29th, containing the largest studio in Great Britain, is proof of this.

Broadcast rivalry has always been keen between Glasgow and Edinburgh, and the fact that the Clydeside city now takes second place is not likely to diminish the antagonism.

oooo

Heard at Hogsmorton.

Gillie Potter states that he will begin on December 12th a new series of talks entitled "Heard at Hogsmorton." In these talks, he aims, so he says, "to tell the truth," and the first of the series will deal with "The Truth about Russia."

Lest Gillie's announcement should be regarded too seriously, it should be explained that he is to take part in a harmless vaudeville programme on the regional wavelengths.

Other well-known artistes who are broadcasting that evening are Ronald Gourlay, Clara Evelyn, the Bayan Singers, Florence Marks, and Wilfred Shine, the two latter collaborating in "Making the Match" and "Courting at the Cross-Roads."

oooo

Ex-Kaiser as B.B.C. Patron.

The Ex-Kaiser has announced his intention of listening to the Welsh service which will be relayed from Aberpergwm Church, Pont-Neath-Vaughan, in the National and Cardiff programmes on December 21st.

The Rev. J. L. Thomas, who conducts the service, recently wrote an account of his visit to the Ex-Kaiser at Doorn.

oooo

A Gaiety Programme.

Excerpts from "The Love Race" will be relayed from the Gaiety Theatre on December 23rd in the National programme. The artistes to be heard by listeners include Laddie Cliff, Stanley Lupino, Madge Elliott, Connie Emerald and Fay Martin.

oooo

A Grand Work Rarely Heard.

Few opportunities occur of hearing Beethoven's great "Missa Solemnis"; therefore, when it is performed at the B.B.C. Symphony Concert on December 17th, listeners should take the opportunity of hearing this amazing work.

The soloists will be May Busby, Muriel Brunskill, Parry Jones and Horace Stevens. The National Chorus will also take part, and the conductor will be Hermann Scherchen.

oooo

Still Going Strong.

One of the most worthy of Scotland's musical activities attains its diamond jubilee this year. The Glasgow Amateur Orchestral Society has held an honourable place for fifty years in Glasgow music, and many of those who will listen to its concert from the Glasgow and Aberdeen stations on December 21st will remember the admirable work which it has done. Its present conductor, Mr. J. Peebles Conn, has had a varied experience.

FUTURE FEATURES.

National (261 and 1,554 metres).

DECEMBER 14TH.—Religious Service from St. Martin-in-the-Fields.

DECEMBER 16TH.—The Prince of Wales speaking at the Annual Banquet of the Incorporated Sales Managers' Association, relayed from Guildhall.

DECEMBER 17TH.—B.B.C. Symphony Concert, relayed from Queen's Hall.

DECEMBER 18TH.—"The Flowers are Not for You to Pick," a play for the microphone by Tyrone Guthrie.

DECEMBER 19TH.—"The Messiah," by the Philharmonic Choir, relayed from the Royal Albert Hall.

DECEMBER 20TH.—Running commentary on the second half of the Association Football Match, Arsenal v. Newcastle United, relayed from the Arsenal Football Ground, Highbury.

National (1,554 metres only).

DECEMBER 15TH.—Commemoration Service, relayed from King's College.

DECEMBER 17TH.—Symphony Concert from the Pavilion, Bournemouth.

DECEMBER 20TH.—A Carol Concert by the Royal Choral Society, relayed from the Royal Albert Hall.

London Regional.

DECEMBER 14TH.—Symphony Concert.

DECEMBER 15TH.—Brass Band Concert (from Newcastle).

DECEMBER 16TH.—Concert by the Choral and Orchestral Union of Glasgow, relayed from the St. Andrew's Hall (from Glasgow).

DECEMBER 17TH.—Polish National Programme, relayed from Warsaw.

DECEMBER 19TH.—"The Flowers are Not for You to Pick," a play for the microphone by Tyrone Guthrie.

DECEMBER 20TH.—Vaudeville programme.

Midland Regional.

DECEMBER 14TH.—Excerpts from Bach's "Christmas Oratorio," relayed from Malvern College, Malvern.

DECEMBER 16TH.—Programme of Folk Songs and Dances.

DECEMBER 18TH.—Carol Service from St. Martin's Parish Church, Birmingham.

DECEMBER 20TH.—Programme of Folk Songs of the Manx, arranged and introduced by Dr. James Lyon.

West Regional (Cardiff).

DECEMBER 15TH.—"Hard Graft," by Wally Bishop, feature programme.

DECEMBER 16TH.—Orchestral programme relayed from the Patti Pavilion, Swansea.

DECEMBER 20TH.—A Christmas Concert, relayed from The Assembly Room, City Hall.

North Regional (Manchester and Leeds).

DECEMBER 15TH.—Choral and Orchestral concert.

DECEMBER 16TH.—"Footlights," orchestral programme of Romance, Comedy and Drama from Famous Musical Comedies.

DECEMBER 20TH.—"The Ship," a play in three acts, by St. John Ervine.

Glasgow.

DECEMBER 19TH.—A Scottish Concert.

Belfast.

DECEMBER 14TH.—A Carillon recital.

Unbiased by Free Grid

THE so-called festive season is now hard upon us, and everywhere our female friends and relatives are engaged in their annual occupation of choosing for us socks and ties of ghastly hue which we must perforce wear until we can have a convenient accident with the accumulator acid. Our male friends with an air of conscious superiority are probably engaged in choosing for us perfectly useless wireless gadgets, useless, that is, to us. Last year I well remember an uncle of mine who is usually described on the charge sheet as being of no fixed abode, presented me with a kit of parts of American origin which the label on the box said could be assembled in half an hour by a child, the only tools necessary being the kitchen poker and a coal hammer, or something like that; the latter implement was presumably to be used *after* assembly. Fortunately, I was able to trade it with a neighbour for a rattling good high-resistance voltmeter with which a well-meaning but misguided aunt had endowed him. He went away quite cheerfully under the firm impression that he had got the better of me, and so everybody was happy.

Things do not always turn out so fortunately, however, and at this time of the year, amid the usual avalanche of bills, final demands and impassioned appeals from the rate-collector which the postman thrusts through my letter-box every morning, there is usually a number of letters from relatives and so-called friends asking my advice on what would be the most suitable thing to present to Oscillating Oswald. This year I intend to save my note-paper by giving my advice publicly by the kind permission of the Editor. Incidentally, all friends and relatives who read this might make a note of the fact that I am myself not averse to receiving a gift. My soul is at present craving for a certain moving-coil loud speaker which is too expensive for me to buy. My heart is so set on this particular instrument that if I do not get it I fear that I shall have to resort to the rather low-down trick of substituting Mrs. Free Grid's pearl necklace by a "Woolworth" (she would never know the difference, and, indeed, my only fear is lest it be a "Woolworth" already), or of extracting coin of the realm from the money boxes of all the little "Grid Leaks," by the old trick of using a table knife in the manner so well known to some of us in the days of our youth.

". . . the kitchen poker and a coal hammer . . ."

The Buyers' Guide.

And now for fourpenn'orth of advice, as the reader said to *The Wireless World* Information Department. Make it a rule never to send a radio gift unless you have first found out something about what the intended recipient already possesses. Such information can usually be obtained from the local bailiff, or even the pawnbroker. Failing everything else the neighbours would, I feel sure, be only too ready to oblige. It is quite useless, and, indeed, a direct incitement to grand larceny, to give a man a power pentode unless he already has an eliminator capable of supplying the necessary volts and milliamperes. Equally it is foolish and a deliberate incentive to the use of "insulting words and behaviour whereby a breach of the peace might have been occasioned" to give a four-and-sixpenny voltmeter to any local expert who is known to indulge in the secret vice of reading the Q. and A. columns of *The Wireless World* stealthily at night after his last client has departed. A moving-coil loud speaker given to a man not possessing a valve set is like a red rag to a bull, whilst, on the other hand, the gift of a suitable set of valves just after the high-tension battery has been accidentally connected to the L.T. terminals of the set would melt the heart of an Editor, and a timely gift in similar circumstances has been known to cause wireless set designers to cry like human beings.

". . . note their faces registering delighted surprise . . ."

To the housewife anxious to please her radio-minded family I would say fill the Christmas pudding this year with a fair sprinkling of miniature fuse lamps instead of with sixpences, and note their faces registering delighted surprise—as the American put it—when they bite upon these toothsome delicacies. Nor must we forget the disgruntled next-door neighbours; what could be so redolent of that old-world chivalry which radio has done so much to destroy as a postal order for 2s.? this representing the cost of the summons which they have been threatening to take out against us

Unbiased.—

all the year for committing a nuisance with our loud speaker.

To fathers who are thinking of making a receiver for their young hopefuls I would utter a special word of warning lest the fate which recently overtook a friend of mine befall them also. He, poor soul, spent many evenings constructing a wireless receiver which he intended as a birthday offering. Unfortunately, he was unaware that his offspring was an ardent reader of *The Wireless World,* and so he foolishly included anode bend rectification in the design, thinking that he would get away with this anachronism. When the great day arrived, however, he speedily wilted under the scornful glance of his son and heir, and there was nothing left for him to do but to hang his head shamefacedly and murmur, "I done it" in imitation of one of the classic figures of history.

The Calibrated Canine.

In my mail—as the Americans put it—the other morning was a letter from a man who for want of something better to do had been reading some remarks I made not so very long ago concerning peculiar causes of distortion in high-powered amplifiers. He was interested chiefly in the detrimental effect on quality which is produced when the amplifier is oscillating at a frequency just above the normal range of audibility, and had, so he asserted, quite accidentally discovered an entirely novel method of diagnosing the trouble immediately it started. He had been puzzled for some considerable time by the fact that his dog, an animal of unknown vintage, set up a mournful howl at times, and, since careful observation showed him that this did not *always* coincide with the broadcasting of a certain type of music beloved of the B.B.C., he was at a loss to account for it.

One day, however, a perfectly simple, but nevertheless astounding, explanation occurred to him, and hasty work in his modest laboratory confirmed his worst suspicions. His investigations showed him that his amplifier was prone to go into self-oscillation at a frequency somewhere round about 12,000 cycles, and this apparently had an irritating effect upon that which he terms his dog's "auditory perceptions." A varied assortment of dogs was hastily collected from neighbours, but they appeared unresponsive.

The conclusion he draws from this phenomenon is that his dog must be a specially gifted animal, and worth

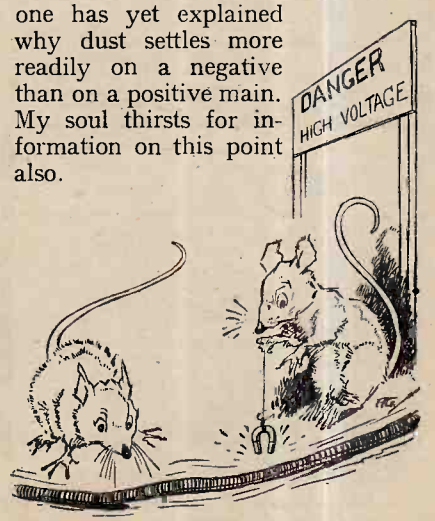
". . . dogs guaranteed to resonate at certain frequencies . . ."

its weight in grid leaks. I have written to him, however, pointing out the fact that in my opinion it is more likely that the lack of response from the other dogs was due to the fact that they were resonant to different frequencies. I have suggested to him that he puts the whole case into the hands of the Radio Research Board, who would, judging from my knowledge of them, just revel in investigating a case of this kind. Probably by pooling their knowledge and resources with the Dog Breeders' Association they could eventually produce dogs guaranteed to resonate at certain frequencies with a very small percentage of error; indeed, they might even undertake to calibrate our own domestic pets, and I can foresee the day when the Radio Doctor will be furtively going about with a truly hang-dog expression, dragging on a lead this latest addition to his collection of meters and other paraphernalia.

Rats!

It so happened that in the course of conversation with the engineer in charge of the municipal power station in one of our northern boroughs I retailed the anecdote of the resonant dog. He thereupon asked me in all seriousness whether I could tell him why rats often attack A.C. mains in the cellar of a house but invariably leave D.C. mains severely alone. I had to admit I was not even aware of this remarkable discrimination on the part of these sagacious rodents. Now I am perfectly aware of the fact that rats in search of liquid refreshment after closing hours, and when other sources are not readily available, will often gnaw through lead water-pipes—presumably they have long ago learnt to attach the same significance to the sound of water passing through a pipe as some of us have to associate with the fizzing of a syphon. I suggested to him, therefore, that owing to an acute sense of hearing these animals were able to detect a faint 50-cycle hum in the case of A.C. mains, and that they confused this sound with that of the water-pipe.

He rightly reminded me, however, that an electric main carrying A.C. could only waggle itself at the frequency of the current passing through it if it had some external magnetic field to react with, such, for instance, as could be supplied by even a "Woolworth" magnet. He suggested that the alternating current produced a super audible "sound"—pardon the paradox—which was received by the rat through the medium of its whiskers. At any rate, whatever be the explanation, conversation with other engineers of wide experience in these matters has convinced me that this is a solid fact, and not a mere flight of fancy on his part. If anyone can think of a feasible explanation I should be glad if they would communicate with me c/o the Editor. So far as I am aware, however, no one has yet explained why dust settles more readily on a negative than on a positive main. My soul thirsts for information on this point also.



". . . remarkable discrimination on the part of these sagacious rodents . . ."

RELAYING MOROCCO.

As the result of an agreement between Radio Toulouse and Rabat, Morocco, the short-wave transmissions from the latter station will be rebroadcast every Saturday from Toulouse.

oooo

FRANCE'S COLONIAL STATION.

The new short-wave station destined for communication between France and her Colonies is approaching completion. It will be installed at Pontoise, near Paris, and will probably begin its trial tests during next January. It will be officially opened, if these tests go well, in February.

The aerial power will be 30kW., and it is hoped that the station will be heard in all the French Colonies of the world.

oooo

EXHIBITION IN SHEFFIELD.

A Radio Exhibition will be opened to-day (Wednesday) at the Victoria Hall, Sheffield, lasting for three days. Admission will be free, and, we understand, the local dealers and experimenters have sent many interesting exhibits, including a model electric railway controlled by photo-electric means.

oooo

RAIDS ON ITALIAN PIRATES.

The Italian authorities are making strenuous efforts to suppress unlicensed receivers and transmitters. Not only have the police the right to search private dwellings if they suspect that they harbour unlicensed receivers, but it is stated that a wireless dealer may not even sell a battery to a customer unless he can produce his listener's licence.

oooo

DIRECT RADIO-TELEPHONE TO SOUTH AMERICA.

The Postmaster-General stated in the House of Commons that he hoped to provide a direct telephone service, within the next two or three weeks, with Argentina. This service will also afford communication with Uruguay and Chile by means of land lines from Buenos Aires. He was also considering the question of direct telephone communication with Brazil.

oooo

PENALTIES FOR "MAN-MADE STATIC."

Belgium seems determined to stamp out, as far as possible, all interferences to listeners caused by industrial motors. We hear that several towns have begun a campaign against "man-made statics," and the municipality of Ciney in the province of Namur has warned every possessor of electric apparatus that he is bound to put it, and keep it, in such a state as to cause no trouble to wireless reception. A maximum penalty of seven days in gaol may be inflicted on those who transgress a second time. Our correspondent tells us that similar measures are being taken in other towns.

oooo

SARDINIA AND THE MAINLAND.

Radiotelephonic communication between Sardinia and the Continent has now been in operation for a month. It is stated that it is impossible to intercept communication between the island and Italy.

CURRENT TOPICS

Events of the Week in Brief Review.

RADIO VITUS RESUMES.

Radio Vitus is now installed at Romainville, near Paris, and is transmitting on 316 metres.

oooo

LOUD SPEAKERS IN ST. PAUL'S.

The acoustic properties of St. Paul's Cathedral have always proved a source of difficulty to preachers, few of whom are able to make themselves heard distinctly in all parts of the building. Experiments are now being conducted with amplifiers and loud speakers, which, it is hoped, will result in rendering all parts of the service clear and distinct to every member of the congregation throughout the building. The problem is complicated, and we understand that the engineers are not yet entirely satisfied with the results.

oooo

FROM TWO POINTS OF VIEW.

The lament of the pessimist that people are already becoming weary of broadcasting is strongly negatived by the verdict of the country readers of a French publication which recently invited them to classify, in order of merit and under the separate heads of "Pleasure" and "Utility," the seven modern inventions most deserving to be singled out and encouraged on account of their value to rural residents.

Under the heading of "Pleasure," wireless came in an easy winner, followed by motoring, cinema, electric lighting, the gramophone, cycling and photography. In the "Utility" class wireless was placed third, being beaten by electric lighting and water supply, but it still took precedence of the motor car, the telephone and the bicycle.

oooo

PROPOSED SUPER HIGH-POWER STATION FOR U.S.A.

In an address given by the Editor of "Electronics" at the Institute of Radio Engineers, he predicted that, as a solution to the problem of clearing the broadcasting ether of its present congestion, the use of 1,000 kilowatt broadcasting stations would become a recognised necessity, this being the only way in which the millions of listeners scattered in far-off towns and villages could enjoy an effective broadcast service.

oooo

WIRELESS TRADERS IN I.F.S.

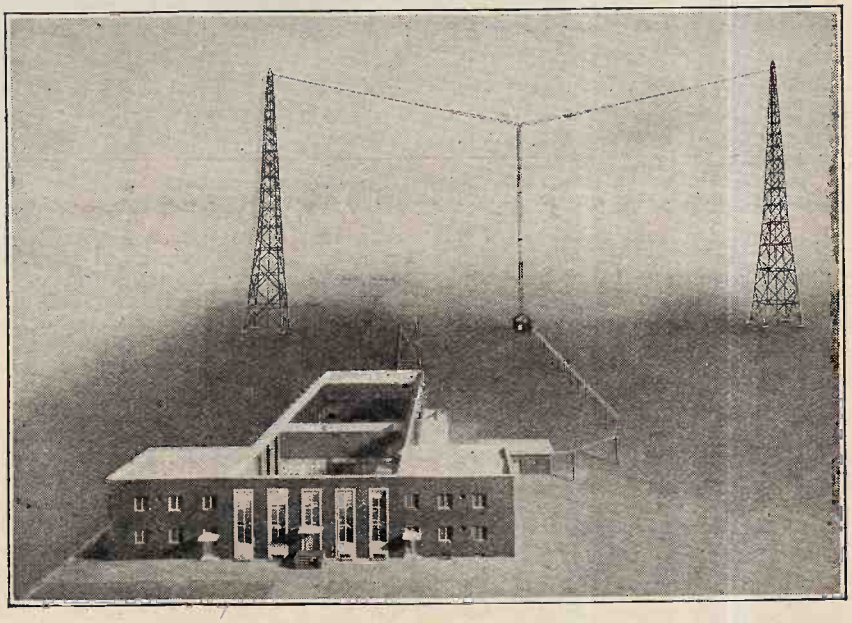
A new Irish radio trade association is in process of formation, which will, in addition to looking after the commercial interests of its members, co-operate with other Irish radio societies and the authorities in an effort to popularise the use of broadcasting in the Irish Free State.

A meeting will shortly be held in Dublin to consider the matter, which, we understand, has the strong support of the existing Irish Radio Traders' Association.

oooo

LYONS AMATEURS' VALUABLE HELP.

During the recent landslide at Lyons where a great number of houses were swept away, the local Radio Club



ANOTHER GERMAN GIANT. A model of the new high-power broadcasting station which opens to-day (Wednesday) at Heilsberg, Eastern Prussia, working on a wavelength of 276 metres and a power of 75 kilowatts. Like its companion station at Mühlacker, the new station can increase its output to 120 kilowatts.

mobilised a contingent of listeners to work in co-operation with the 35th Aviation Regiment. Microphones were placed on the ground on the edge of the devastated region where rescuers were at work and signalled the faintest crack or movement in the danger zone, thus giving timely alarm to the rescue parties and preventing further loss of life and property. A number of local radio dealers freely supplied the necessary apparatus for this invaluable service.

oooo

WIRELESS ON TRAINS.

Radio Fer, the company which has equipped the Paris-Brest line, expects to have 150 cars complete with wireless installation and running by the end of this month. And by the end of next year it is confidently predicted that there will be at least 500 cars so equipped.

The object of these cars is to provide continuous telegraphic communication between passengers on the trains and the Post Office Central Station at Pontoise.

oooo

A RADIO RELIC.

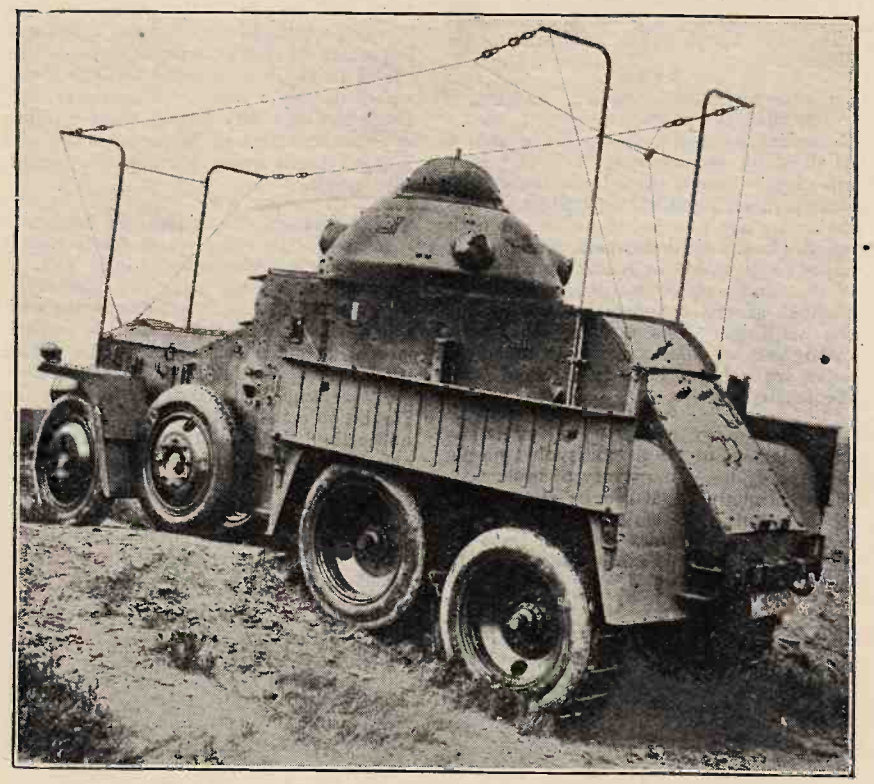
A deserted shack which for years has stood neglected near Babylon, Long Island, U.S.A., has suddenly gained fame, having been identified as one of the first wireless stations in America and used by Guglielmo Marconi about 1900 (says *The New York Times*). The building has been moved to the reservation of the Radio Corporation of America at Rocky Point, Queens, and will be preserved as a historical relic and house a radio exhibit.

It was in the late autumn of 1900 or the early part of 1901 that Marconi located his Long Island transmitter at what was then the outskirts of Babylon and near the coast line, where his wireless station might have best communication with incoming vessels while they were still some distance from New York Harbour. During the years that followed the building was abandoned for larger quarters.

oooo

INCREASE OF WIRELESS IMPORTS INTO ITALY.

Italy at one time seemed rather to be lagging behind her neighbours in the expansion of her wireless trade, and it is, therefore, a matter for congratulation to record that her imports of wireless apparatus from January 1st to August 31st of this year amounted in value to 62,586,548 lire, as compared with 49,124,289 lire for the corresponding period of 1929, and 16,652,343 lire for 1928. Her exports for the first eight months of this year amount to 1,550,194 lire, as compared with 1,016,410 lire in the preceding year.



ARMOURED CAR WIRELESS. The latest type of travelling fort in use by the R.A.F. The wireless aerial is carried on collapsible metal masts.

oooo

A REVOLT AGAINST BROADCAST ADVERTISING?

Mr. Ira E. Robinson, a member of the Federal Radio Commission, predicts a revolt on the part of American listeners against excessive advertising in their broadcast programmes. He asserted that "the overdose of advertising on the radio is fulsome and eventually will ruin the business of advertising by radio. The excesses of the broadcasters, in their greed for commercial gain, will assuredly bring about a revolution among listeners."

R.M.A. BANQUET.

That the Radio Manufacturers' Association represented a total invested capital of nearly £80,000,000, every penny of which was British, was one of the facts referred to by Mr. William Adamson, M.P., Secretary of State for Scotland, in his speech at the annual dinner of the R.M.A., held at the Savoy Hotel on Wednesday last, and presided over by Sir William Bull, M.P.

Mr. Adamson, proposing the toast of the Association, said that the 3,250,000 wireless licences now issued represented a listening public of 13,250,000. There was reason to suppose that within the next year the total figure might have passed the 4,000,000 mark.

Capt. J. W. Barber, chairman of the Association, replied to the toast. The toast of "The Guests," proposed by Mr. R. Milward Ellis, was acknowledged by the Solicitor-General, the Hon. Sir Stafford Cripps.

oooo

MOTOR CYCLE WIRELESS SETS.

A demonstration by the first motor cycle wireless units in use in this country took place on Wimbledon Common on Wednesday last, when messages were transmitted from one unit and received by another unit, belonging to the 47th (2nd London) Divisional Signals (T.A.).

The outfits employed consisted of two standard motor cycles, each drawing a two-wheeled "covered wagon" trailer equipped with wireless transmitting and receiving apparatus.

The motor cycles and trailers were first halted about a hundred yards from each other, and a test message from the commanding officer, Lt.-Col. T. W. Vigers, M.C., was transmitted from one outfit to the other with perfect accuracy. Equally successful results were obtained at ranges varying from one to three miles.

oooo

WIRELESS AT WESTMINSTER.

By Our Special Correspondent.

Empire Broadcasting Scheme.

Mr. Viant, the Assistant-Postmaster-General, stated that a scheme proposed by the British Broadcasting Corporation for the provision of an Empire broadcasting service was submitted to the Communications Committee of the Imperial Conference. One of the details of the scheme was the broadcasting of three news bulletins daily, which it was stated would be supplied to the British Broadcasting Corporation by a news agency on terms which had been arranged with them. A copy of the scheme and of the Communications Committee's report on it would shortly be published. The Committee recommended that, as a first step, the British Broadcasting Corporation should communicate particulars of the scheme to the broadcasting authorities in the Dominions, and should ascertain their views on the subject.

If, after studying the scheme, any Press organisation wished to discuss the proposed arrangements for the broadcasting of news, he would suggest that it should approach the British Broadcasting Corporation.

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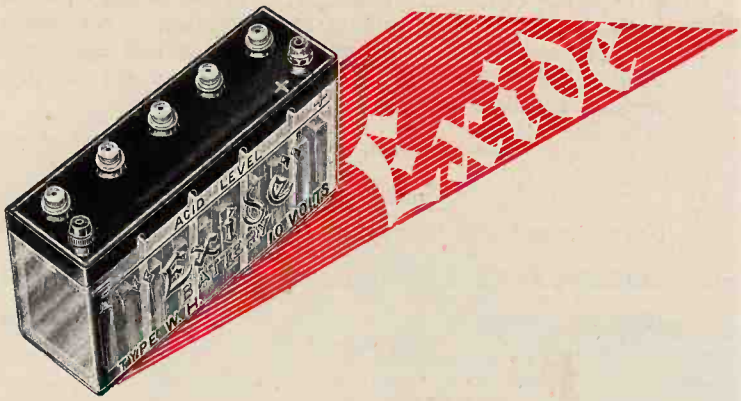

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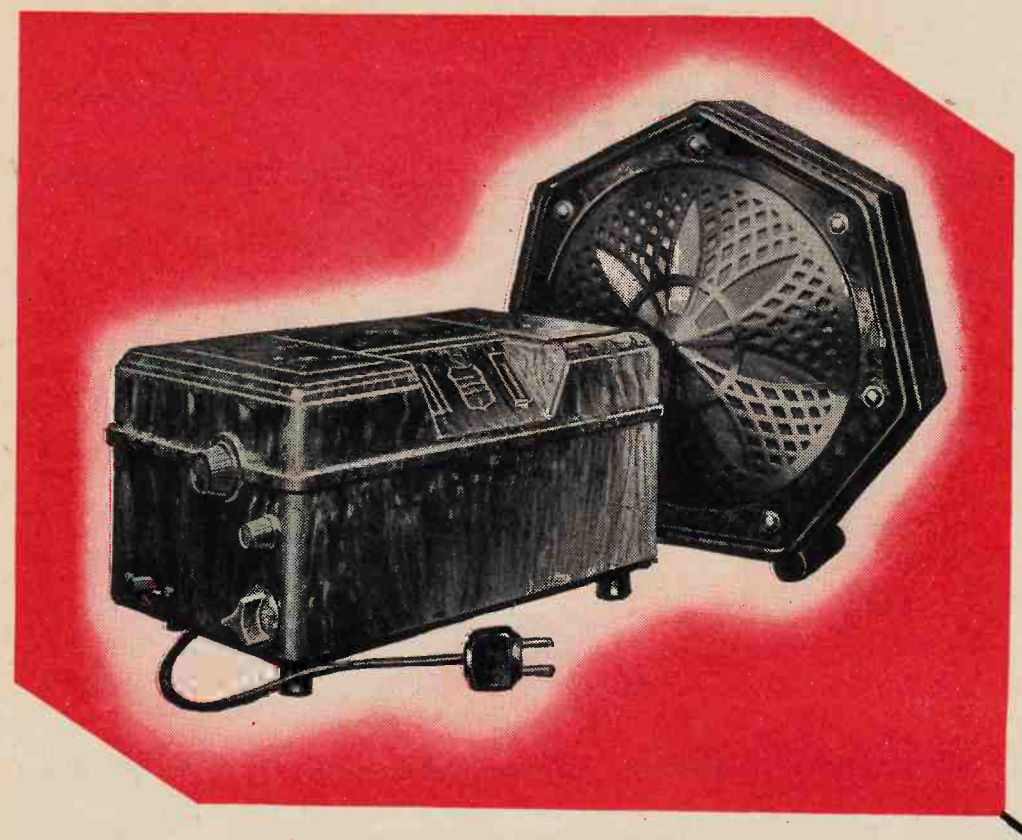

The new Philips 3-valve set for A.C. mains, type 2531, is enjoying enormous popularity. It has already proved itself the outstanding success of the season. All rotary controls are at the sides and the tuning dial lights up. Philips loudspeaker type 2019 matches the set exactly, making an ideal combination.

Price complete, ready for operation,

£23.0.0

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Arks.

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The Theory of THE VALVE AMPLIFIER

Choke-Capacity Coupling in the H.F. Stage.

By S. O. PEARSON, B.Sc., A.M.I.E.E.

(*Concluded from page 586 of November 19th issue.*)

WE turn now to the type of coupling in which a choke is connected in the anode circuit of the first of two valves to be coupled in cascade, the actual coupling to the grid of the second valve being effected through the medium of a coupling condenser in the manner described for resistance-capacity coupling in the preceding section. The circuit arrangement is exactly the same in every respect as that for resistance-capacity coupling, except for the substitution of a suitable choke in place of the external anode resistance R in Fig. 1 of the previous instalment. The circuit now under review is, therefore, as shown in skeleton form in Fig. 1, where Z represents the choke in the anode circuit of the first valve.

The Action of a Choke.

"Choke," or "choking coil," is the name given to a coil of wire designed specially to offer a high degree of opposition or *impedance* to an alternating current through it by virtue of the *back electromotive force* arising as a result of self-induction, the resistance being moderately low, so that direct current is allowed to pass comparatively freely. From this it follows that one of the chief advantages of choke coupling over resistance coupling is that the mean potential of the anode of the valve is maintained at a value approximately equal to that of the positive terminal of the source of H.T. current, only a small voltage being lost in the actual resistance.

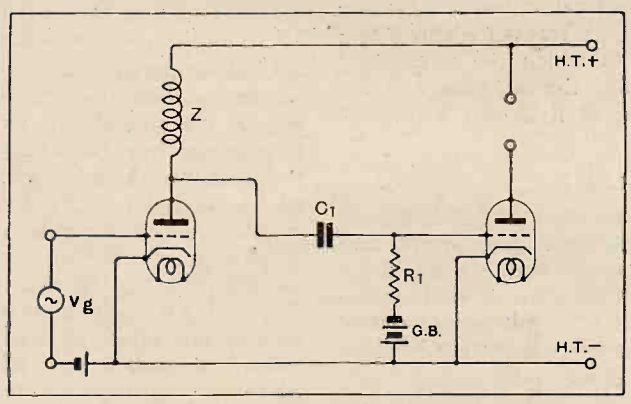

Fig. 1.—Connections for choke-capacity coupling.

One or two notes on the nature of reactance and impedance will be helpful in view of what is to follow:—An electromotive force is always *induced* in the turns of a coil when the magnetic field linked with that coil is changing in value. If the field is produced by a current in the coil itself, an E.M.F. will appear whenever the current is changing, and this property is called self-induction. The self-induced E.M.F. always acts in such a direction as to oppose the changing of the current, this being known as Lenz's law.

The practical unit of self-inductance is the *henry*. A circuit has a self-inductance value of one henry if one volt is induced in it when the current is changing at the rate of one ampere per second.

Reactance.

When a sine wave of alternating current is passed through a coil possessing inductance, the continuous changing of the current from instant to instant results in the generation of an electromotive force in the coil, opposing the passage of the current or tending to "choke" it back, this E.M.F. also obeying the sine law. The degree of opposition due to self-inductance depends not only on the inductance value of the coil but also on the frequency of the current, because the maximum rate of change of the latter is proportional to the frequency. If L is the inductance of the coil in henrys, and f the frequency of the current in cycles per second, the R.M.S. value, or effective value, of the generated back E.M.F. is equal to $2\pi fL \times A$ volts, where A is the R.M.S. value of the current, the value indicated by an A.C. ammeter.

The quantity $2\pi fL$ is called the *reactance* of the coil at the frequency f. It is the number by which the current must be multiplied to give the induced E.M.F. of self-induction, and is expressed in ohms, because, like resistance, it is equal to the ratio of voltage to current. But it differs from resistance in one very important respect, namely, that the current and induced E.M.F. are exactly a quarter of a cycle out of step, whereas for pure resistance the current and voltage are exactly in phase.

Impedance.

When the current A is one ampere, the generated voltage is numerically equal to the reactance $2\pi fL$, and so, for an inductive coil, the applied voltage required to drive a current of 1 ampere against the back E.M.F. is $2\pi fL$ volts, *this being a quarter of a cycle in advance*

The Theory of the Valve Amplifier.—

of the current. Similarly, if the coil has a resistance of R ohms, the voltage required to drive one ampere through the opposing resistance will be R volts, *this voltage being in step or in phase with the current.* Consequently, for a coil possessing both resistance R ohms and reactance $2\pi fL$ ohms, the total voltage that will be necessary to drive a current of *one ampere* through the coil will be equal to the sum of the voltages R and $2\pi fL$. But the addition cannot be made by simple arithmetic, because these two voltages are a quarter of a cycle out of step. Each must be represented by a straight line whose length gives its magnitude, the two lines being mutually at right angles, as shown in Fig. 2, where the lengths *oa* and *ob* represent R and $2\pi fL$ respectively.

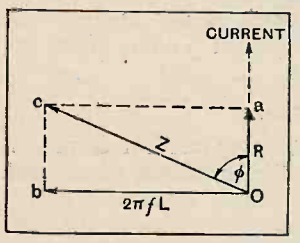

Fig. 2.—Voltage vectors for an inductive coil when the current is 1 ampere.

On completing the rectangle *oacb,* and drawing the diagonal *oc,* the latter gives the total voltage required to drive one ampere through the coil; its length is denoted by Z, and is given by $Z = \sqrt{R^2 + (2\pi fL)^2}$. This quantity Z is equal to the voltage necessary to drive one ampere through the coil against the opposing effects of both the resistance and the reactance. Thus the voltage V necessary to drive a current of A amperes through the coil will be $V = A.Z.$ volts, or, for a given voltage V, the current will be $A = \frac{V}{Z}$ amps.

The quantity Z is thus the total opposition to the passage of the current due to both reactance and resistance. It is the total extent to which the alternating current is impeded, and is called the *impedance* of the coil, being expressed in ohms, as it is also a ratio of voltage to current.

Angle of Lag.

For a simple resistance the current and voltage are in phase, and for a pure reactance the current and voltage are just 90° out of step; and, as might be expected, for a circuit with a mixture of both resistance and reactance the current and voltage are out of phase by an angle whose value lies somewhere between zero and 90°. This angle is denoted by ϕ in Fig. 2, and its value can be found from the fact that $\cos \phi = \frac{R}{Z}$. We see, then, that for an inductive coil the current *lags* behind the applied voltage by an angle ϕ, and the impedance is given by

$$Z = \sqrt{R^2 + (2\pi fL)^2} \text{ ohms} \quad \ldots \quad (1)$$

A choke is specially designed so that the resistance R is low compared with its reactance $2\pi fL$ at the operating frequency.

Voltage Amplification.

Reverting now to the circuit of Fig. 1, it can be treated in the same manner as was done for the resistance-capacity coupling, but in this case there are phase differences to be taken into consideration. Assuming for the present that the coupling circuit through C_1 to the grid of the second valve is removed and that there are no stray capacities, and that the coil Z itself has no self-capacity, the anode circuit of the first valve resolves itself into the simple form shown in Fig. 3, as far as A.C. components are concerned. R_a represents the A.C. resistance of the valve, and $Z = \sqrt{R^2 + (2\pi fL)^2}$ ohms is the impedance of the choke. The alternating voltage injected into the anode circuit by the action of the valve is denoted by μV_g, where μ is the amplification factor of the valve, and V_g is the alternating voltage applied to the grid.

The total resistance of the closed anode circuit is $R_a + R$, and its reactance is $2\pi fL$ ohms. Thus the total impedance in the circuit is—

$$Z' = \sqrt{(R_a + R)^2 + (2\pi fL)^2} \text{ ohms} \quad \ldots \quad (2)$$

The alternating component of current in the anode circuit is thus $A = \frac{\mu V_g}{Z'}$ amperes. This current, in passing through the impedance Z of the coil itself, establishes a voltage $V = A.Z$ across the choke, so that the voltage theoretically available for transference to the grid of the next valve is—

$$V = \mu V_g \frac{Z}{Z'} \text{ volts,}$$

where Z and Z′ have the values given by equations (1) and (2) respectively. The theoretical voltage amplification $\frac{V}{V_g}$ obtained is therefore

$$n = \mu \frac{Z}{Z'} \quad \ldots \quad (3)$$

Effect of Stray Capacities.

Choke-capacity coupling is suitable for both radio-frequency and audio-frequency amplification; but, of course, the choke must be designed to suit the band of frequencies over which it is to be used. For audio-frequency work the choke is wound on an iron core so as to give a high value of inductance, whereas for high-frequency operation it is impracticable to use an iron core in the usual way. Radio-frequency chokes are air-cored and wound in such a way as to reduce self-capacity to a minimum; but, even so, at radio frequencies the effects of self-capacity and the inter-electrode capacities of the valves exert almost a controlling influence on the action of a choke when used in the manner indicated by Fig. 1.

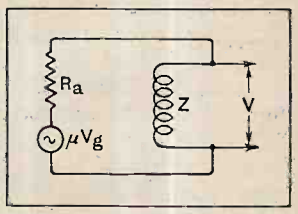

Fig. 3. — Equivalent A.C. circuit for a valve with impedance Z connected in the anode circuit.

In dealing with the resistance-capacity coupling it was shown by means of simplified equivalent circuit diagrams that the various capacities were, in effect, all in parallel across the external anode resistance, and this is also the case in the present instance. Now, a condenser in parallel with an inductive coil constitutes a

The Theory of the Valve Amplifier.—circuit tuned to a definite frequency $f = \frac{1}{2\pi\sqrt{LC}}$ cycles per second, where L is the inductance in henrys and C the capacity in farads; and at this resonant frequency the combined circuit has its maximum impedance, its value being $\frac{L}{CR}$ ohms, where R is the effective equivalent high-frequency resistance of the coil, accounting for all sources of power loss.

From equation (3) it is clear that the voltage amplification is enhanced by having the greatest possible effective coil impedance Z compared with the A.C. resistance of the valve. So that, but for the effects of capacity, the highest values of inductance would give the best results. As it is, the inductance value is chosen in relation to the total shunting capacity, so that the effective impedance is greatest over the band of frequencies to be received. Compared with a tuning coil the high-frequency resistance of a choke is relatively high, and the latter is, therefore, not sharply tuned to the resonant frequency by the stray capacities. The tuning is usually quite flat, so that a band of wavelengths of considerable width is covered quite efficiently. Since the circuit responds fairly evenly to a considerable range of frequencies, it is said to be *aperiodic*—that is, possessing no natural period of oscillation.

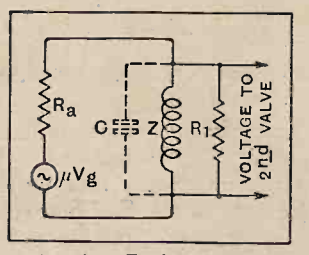

Fig. 4.—Equivalent A.C. circuit for choke-capacity intervalve coupling. The circuit is developed on the assumption that the reactance of the coupling condenser is sufficiently low to be neglected.

Actual numerical calculation of the stage gain at a given wavelength is not a simple matter, even when the impedance and phase angle of the choke are known at the corresponding frequency. Assuming that a negligible fraction of the H.F. voltage developed across the choke is lost in the coupling condenser, the equivalent A.C. circuit between the two valves is of the type shown by Fig. 4, where Z is the choke in the anode circuit of the first valve, R_a is the A.C. resistance of the latter, R_1 is the grid leak resistance between the grid and cathode of the second valve, and C represents the lumped stray capacities, including the self-capacity of the coil, anode-to-cathode capacity of the first valve, and the effective grid-to-cathode capacity of the second valve. This last capacity depends not only on the design of the second valve but also on the nature of the load on its anode circuit. Each of the three circuits in parallel on the right-hand side of the diagram has a different phase relationship between current and voltage, and this in itself renders numerical calculation somewhat involved.

Nevertheless, the difficulty can be overcome to a certain extent by substituting for the choke coil Z itself an equivalent pure reactance and a pure resistance in parallel, thereby modifying the circuit of Fig. 4 still further. However, this particular treatment will be omitted here, but will be included in a forthcoming article dealing with tuned grid coupling, a circuit in which the grid leak R_1 of Fig. 1 is replaced by a parallel-tuned circuit.

The stage gain in voltage has been defined as the ratio of the high-frequency voltage delivered to the grid of the second valve to that applied to the first. But in normal circumstances the voltage impressed between the grid and cathode of the first valve is itself derived from a tuned circuit, and the functioning of this circuit is influenced to a considerable extent by the nature of the anode circuit. Hence, the voltage V_g referred to in the foregoing sections is itself dependent, among other things, on the nature and numerical constants of the intervalve coupling; and so, although it is possibe to calculate the stage gain from grid to grid, the results will not always enable the over-all amplification of a complete amplifier to be obtained. It is hoped in a subsequent article to deal also with this subject.

Catalogues Received.

The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.—Booklet OV 5569, describing Osram power valves and photo-electric cells, and Booklet OV 5568, dealing with A.C. mains and rectifying valves.

o o o o

Colvern, Ltd., Mawneys Road, Romford, Essex.—40-page booklet dealing with Colvern coils, well illustrated and containing theoretical circuits explaining the application of each type of coil described. A section is devoted to switches and resistances.

o o o o

Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1.—Clarostat booklet describing the full range of variable resistances and illustrating their respective uses by means of circuit diagrams.

o o o o

The Edison Swan Electric Co., Ltd., 123-5, Queen Victoria Street, London, E.C.4.—Radio catalogue R.584, dealing with Ediswan receivers, R.K. loud speakers, battery eliminators, and mains transformers.

The Wholesale Wireless Co., 103, Farringdon Road, London, E.C.1.—Illustrated booklet dealing with the Radioglobe range of loud speakers, also folder describing "Radcroix" mains equipment, and folder describing the "Sensitite" range of H.T. eliminator constructional kits.

o o o o

Siemens Bros. and Co., Ltd., Woolwich, London, S.E.18.—The new Full-o'-Power booklet describing the range of H.T. dry-cell batteries.

o o o o

Clarith Reproducers, Ltd., East Street Mills, Leeds.—Illustrated leaflets of Clarith radio-gramophones.

o o o o

Frederick Squire, Ltd., Kings Works, Leswin Place, Stoke Newington, London, N.16.—Illustrated folder describing the "Sylphone" moving-coil loud speaker.

The Rothermel Corporation, Ltd., 24-26, Maddox Street, London, W.1.—80-page catalogue dealing with Benwood Linze metal rectifiers, Centralab resistances, Electrad components, Magnavox loud speakers, and the numerous other lines handled by this firm.

o o o o

Graham Amplion, Ltd., St. Andrew's Works, Slough, Bucks.—32-page illustrated catalogue dealing with the Amplion range of receivers, loud speakers, gramophone pick-up and trickle charger.

o o o o

A. F. Bulgin and Co., 9, 10, 11, Cursitor Street, Chancery Lane, London, E.C.4.—Illustrated catalogue of components and accessories. Many pages are devoted to diagrams and descriptive matter explaining the various uses of their components.

o o o o

Mullard Wireless Service Co., Ltd., Mullard House, Charing Cross Road, London, W.C.2.—"Mullard Rapid Valve Guide," giving in condensed form all the essential information regarding their valves.

LOUD SPEAKER IMPEDANCE

Using an Alignment Chart. Some Practical Examples.

By W. A. BARCLAY, M.A.

(*Concluded from page 630 of previous issue.*)

IN the previous instalment of this article an alignment chart was described which had been specially prepared to relate the numerical values of resistance, inductance, impedance, and frequency for the case of a simple coil possessing fixed inductance and resistance. It was seen that, where these two values are known to be constant throughout the frequency range, a straight line joining these values on the outside scales of the chart will pass through a network of lines relating the frequency to the impedance of the combination.

Finding L and R by Alignment.

We now pass to consider the inverse use of the chart. Suppose the inductance L and resistance R of the coil are unknown, but that by experiment we can measure the current passing through the coil and the voltage across it at various different frequencies. If, for instance, we follow the procedure employed by *The Wireless World* in determining the impedances of the various cone units tested (*vide* issues of February 5th, 12th, and 26th, 1930), we should use the circuit of Fig. 4, in which a valve voltmeter V is placed across the coil to measure the applied voltage, while simultaneously the current passing is measured by the thermo-junction A. As we have already seen, we can determine in this manner the absolute impedances offered by the coil at the various frequencies used.

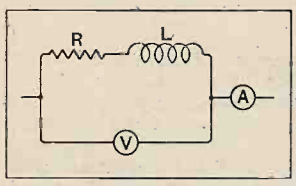

Fig. 4.—Method of obtaining impedance of loud speaker RL by taking simultaneous readings of valve voltmeter V and thermo-junction A.

If we now return to our specially prepared diagram of vertical frequency lines and sloping impedance lines described in the previous instalment, we may proceed to plot on this centre network the positions of various points which will represent values of impedance and the corresponding frequency. This is done in the manner indicated in Fig. 5, where each small circle represents the point of intersection of the appropriate impedance line with its corresponding frequency line. If a fair standard of accuracy has been employed in the work, and the capacity effects and other losses are negligible, *these points will lie approximately in a straight line.* Further, if we draw what we consider to be the best and most representative line through the mean positions of these points, as in the example shown, we may regard the values of R and L in which this line meets the two outer scales as the best values which the experiment indicates for the resistance and inductance of the coil.

The writer hopes that it may not be amiss to point out here that this method, for which he ventures to predict a large future in the analysis of experimental results, represents a considerable advance on the rapidity with which similar approximations are usually obtained. For accurate results, of course, the method of Least Squares will always be preferred by the mathematical physicist; for all ordinary work, on the other hand, and in cases where time does not permit of much laborious computation, the method of alignment provides the ideal tool.

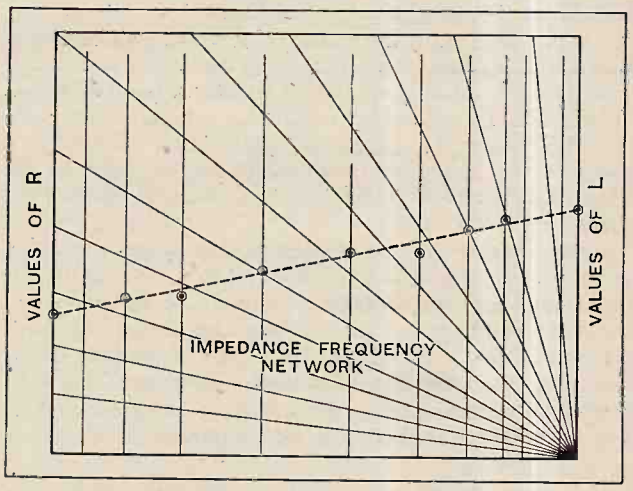

Fig. 5.—Schematic diagram showing method of deriving values of L and R from experimentally related values of z and f. The network of impedance and frequency lines shown here and in Fig. 6 is not accurately drawn, and the lines are not, therefore, numbered. The correct positions of the network lines are given in Fig. 8.

Analysis of Loud Speaker Impedance.

When, however, we come to plot in a similar manner the measured impedance-frequency characteristic of a loud speaker upon our prepared diagram, the problem of obtaining the values of equivalent resistance and inductance to correspond is, at first sight, insoluble. The impedance-frequency points are now found to be no longer distributed along a straight line, but approximate to a curve, as shown in Fig. 6. The reasons for this were given in the first part of this article; in brief, neither the resistance nor the inductance of a loud speaker can be considered constant over the frequency range of the instrument, while, in addition, the effect of the capacity

Loud Speaker Impedance.—

of the windings at the higher frequencies becomes very apparent. It is clearly impossible to draw a "best straight line" through the points on Fig. 6, and the problem would seem as far off as ever from solution.

But the fact that, as we have seen, the effective values

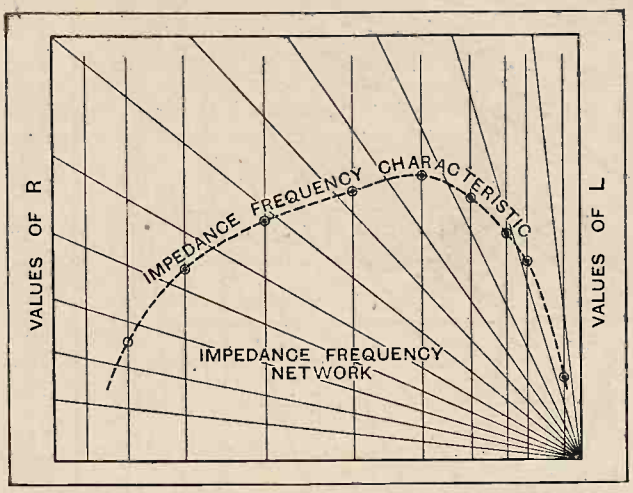

Fig. 6.—The experimental impedance-frequency characteristic of a loud speaker when plotted on the network of the alignment diagram is a curve, indicating that L and R can no longer be regarded as constants. Like Fig. 5, this diagram is schematic only.

of resistance and inductance are themselves dependent upon the working frequency gives us the key to the situation. At each frequency there exist certain definite values of R and L which may be truly said to be effective *at* that frequency, however they may change when the frequency is altered. Let us take, as example, the alignment diagram of Fig. 7, on which we may represent by P the point corresponding to the impedance z and frequency f. For convenience, the network of vertical f lines and sloping z lines is here omitted. Then, as we know, the values of R and L which represent the unit at this frequency will be connected by some straight line which passes through P. Several such lines are shown dotted on the diagram, but which of these is the correct one cannot yet be decided on the strength of a single datum which only fixes the position of the point P itself. If, now, the frequency be slightly changed from f to a neighbouring value, f', and the corresponding impedance z' be ascertained, a new point P′ will be obtained on the chart. *A strong presumption will now exist that the approximate values of R and L over the range f to f' will be given by the line joining P and P′.* And if a further point P″ be found corresponding to another neighbouring frequency, the three points P, P′, and P″ being approximately collinear, the "presumption" will amount almost to certainty that the effective values of R and L over this small frequency band may be read off on the outer scales in a continuation of this line.

It should be carefully noted that the above reasoning does *not* amount to proof, and that cases may sometimes arise where it is, in fact, invalid. What may be called the "circumstantial evidence" is, however, overwhelming; moreover, experimental corroboration of its results in most cases is easy to obtain, as will be shown subsequently.

We have assumed in the above that the position of the index-line used to find R and L could be ascertained from two datum points P and P′ separated by a small interval of frequency. In practice, of course, we need only take account of the *direction* of the characteristic curve at P in order to fix the position of the line, since in the limit, when the frequency interval is small enough, P′ may be taken as coincident with P. In other words, the index-line which gives the effective values of R and L for any frequency is tangential to the impedance-frequency characteristic at that frequency. It will be seen, too, that the variations in these effective values, and their dependence on the working frequency, are thus adequately accounted for.

The simplicity of the procedure is remarkable, considering the complicated nature of the problem. Given the experimental values of impedance and frequency for any loud speaker, we first plot the data on the prepared network of our alignment chart, and then draw as smooth a curve as possible among the several points. The effective values of resistance and inductance are then read off on the side scales for different frequencies by placing the index-line tangentially to the curve at its intersection with the various vertical frequency lines.

Some Typical Examples.

Let us now apply these methods to some of the typical cases for which impedance figures are available. On the prepared diagram of Fig. 8, which is, of course, the same as that of Fig. 3 of the previous instalment, half a dozen curves have been plotted from the figures which

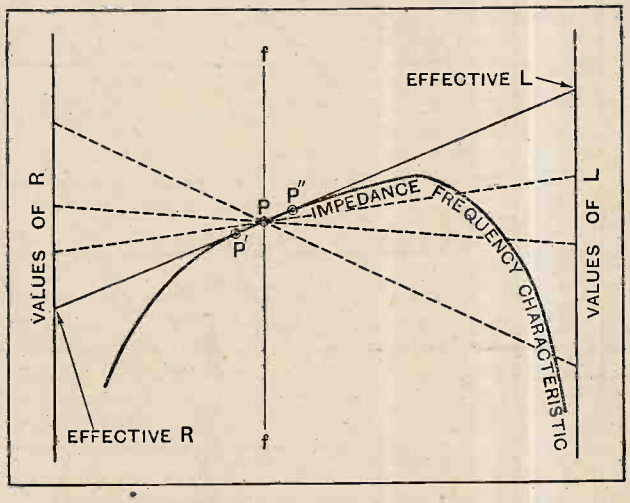

Fig. 7.—Alignment method of deriving effective values of L and R by means of the tangent to the impedence-frequency characteristic. The vertical line for frequency f is alone shown passing through P, the rest of the network being omitted.

were given on page 135 of the issue of February 5th. As an interesting exercise in comparison, the same loud speakers have been chosen for illustration as were selected by A. L. M. Sowerby in his recent article on this subject.[1]

[1] "Matching Valve and Loud Speaker," by A. L. M Sowerby, *The Wireless World*, May 28th, 1930

Fig. 8.—The impedance-frequency characteristics of six loud speaker units are plotted on the alignment diagram of Fig. 3. The effective values of resistance and inductance are obtained by means of the tangents to these curves at the different frequencies.

Loud Speaker Impedance.—
It will be remembered that in Fig. 2 of that article impedance-frequency characteristics were plotted to a logarithmic scale for six different loud speaker units which were distinguished by the numbers 1 to 6. In Fig. 8 of the present article the numbers on the curves relate to the same instruments as those chosen by A. L. M. Sowerby, so that a comparison of the two methods of showing the characteristics can readily be made. In the present case the network is not, of course, logarithmic, but is computed from special functions in order that the alignment properties described above may come into play. By placing a ruler tangentially to each of these curves, therefore, the effective values of resistance and inductance for each may be read off by inspection at each frequency. The results for the instruments numbered (1), (2), and (6) were plotted in the form of ordinary graphs, the frequency axis being, for convenience, taken to a logarithmic scale (see Fig. 9).

an Ediswan cone unit was reproduced, while on the same diagram appeared the characteristic exhibited when the unit was shunted by a condenser of 0.1 microfarad. For the particular frequency of 200 cycles per second the impedance of the speaker itself is shown as approximately 5,000 ohms, while that of the parallel combination is approximately 5,700 ohms. It will now be seen that, if we regard the speaker unit as represented at this frequency by an inductance L and a resistance R, we have here a means of computing the numerical values of these quantities. Details of the calculation are reproduced in the appendix; here it need only be said that the result works out to, approximately, L=2 henrys, R=4,300 ohms.

Now, the Ediswan unit happens to be No. 5 among the units illustrated in Fig. 8. Placing a ruler tangentially through the point on curve No. 5 for the frequency $f=200$ cycles, it will be seen that these values of L and R are fairly well confirmed.

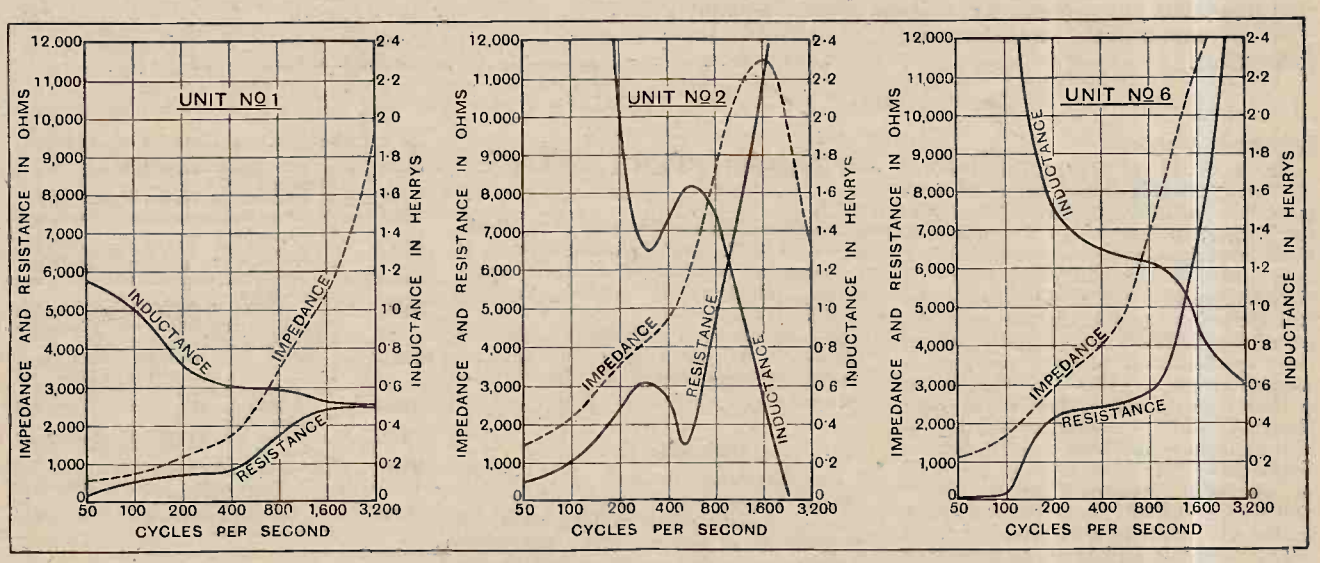

Fig. 9.—Graphs showing the variations in the effective values of resistance and inductance for the units numbered (1), (2) and (6) in Fig. 8.

In each case the impedance-frequency characteristic is shown by a dotted curve. It is interesting to note the variations in the effective resistance of the different instruments, and to remark how widely they differ from the impedance values. In the case of Unit No. 6, the effective resistance maintains a fair degree of constancy over the band of frequencies from 400 to 800 cycles; on the other hand, Unit No. 2 exhibits a noticeable minimum of effective resistance in the same region.

An Experimental Confirmation.

An interesting confirmation of the values of effective resistance and inductance obtained from Fig. 8 may be derived from data contained in an article which appeared in a recent issue of this journal on the subject of combining two cone loud speakers.[2] In Fig. 2 of that article the experimental impedance-frequency characteristic of

The Effect of Self-capacity.

In all that has so far been said, we have tacitly agreed to omit all reference to the self-capacity of the windings of the unit. At the higher frequencies, however, this effect becomes more and more pronounced, and on the highest notes, as we might expect, it entirely counteracts the inductive element in the coils of the instrument. This effect is obvious in the three inductance graphs of Fig. 9, the effective inductance ultimately becoming very small, and in certain cases, *e.g.*, that of Unit No. 2, even appearing to become negative. This, of course, is due to the subtractive nature of the capacitative reactance, which at the higher frequencies tends to neutralise the positive inductive reactance.

Another curious effect, noticeable in some loud speakers, though not in others, is elicited by reference to Fig. 8. For certain frequencies, say, over 1,600 cycles per second, the effective resistance as found by the diagram becomes even greater than the impedance value itself! For instance, the curve shown in Fig. 9 for Unit

[2] "Dual Unit Loud Speaker," *The Wireless World*, June 18th, 1930.

Loud Speaker Impedance.

No. 2 shows this rather remarkable peculiarity. The explanation of this apparent paradox is, however, simple. It is due entirely to the shunting effect of the self-capacity at these frequencies. It will be remembered that one of the conditions which were assumed in the construction of the alignment diagram was that such capacity effects should be negligible. Clearly, therefore, we must not expect reliable results from it under conditions when, as at the highest frequencies, self-capacity plays a prominent rôle. For all low and medium frequencies, however, the assumptions made are legitimate.

For the rest, it is believed that this method of obtaining the effective value of the working resistance of a loud speaker will not be without its value in estimating the power output supplied by the last valve of the amplifier. It must, of course, be remembered that this power output is not at all the same thing as the useful power consumed by the loud speaker, which depends only on that small part of the effective resistance which is actually used in the acoustic transformation effected by the instrument.

APPENDIX.

If L and R denote the effective values of the inductance and resistance for the frequency $f=200$ cycles, we have, where z denotes the impedance of the loud speaker at this frequency,

$$z^2=R^2+\omega^2L^2.$$

Also, if C be a shunting capacity, the total impedance of the parallel combination at the same frequency is Z where

$$Z^2=\frac{R^2+\omega^2L^2}{\omega^2C^2R^2+(1-\omega^2CL)^2}$$

$$\text{Rearranging, } \left(\frac{1}{\omega C}-\omega L\right)^2+R^2=\frac{z^2}{\omega^2C^2Z^2}$$

$$\text{i.e., } \frac{1}{\omega^2C^2}-2\omega L\,\frac{1}{\omega C}=z^2\left\{\frac{1}{\omega^2C^2Z^2}-1\right\} \quad \ldots\ldots \text{(a)}$$

Now by measurement, at $f=200$, $z=5{,}000$, $Z=5{,}700$, while the condenser being 0.1 mfd., will have a reactance $\frac{1}{\omega C}=8{,}000$.

Substituting these values in equation (a), we have

$$64\times10^6-\omega L\times16\times10^3=25\times10^6\times\left\{\frac{64}{32.5}-1\right\}$$

$$\therefore\ \omega L=2.5\times10^3$$

$$\therefore\ L=2 \text{ henrys.}$$

Again,

$$R=\sqrt{z^2-\omega^2L^2}$$
$$=\sqrt{25-6.3\times10^3}$$
$$=4{,}300 \text{ ohms.}$$

Low-power Working.

Mr. M. W. Pilpel (G6PP), Cricklewood, has been carrying out a series of low-power tests with G2ZC, Mr. A. M. Houston Fergus, in Jersey. In the course of these experiments he first reduced his power to 2 mA. at 10 volts, when his signals were reported as R1-2. Later he still further reduced his power until the input was 0.0135 watts, supplied by an ordinary flashlamp battery, and signals were still reported as R1-2, though, owing to interference, only a few words were readable. G2ZC, however, stated that, if no interference had been encountered, he would have been able to copy about 80 per cent. of the message if each word were sent twice. G6PP finds that his transmitter will oscillate quite strongly with only 2 volts on the plate of the valve, and is awaiting a favourable opportunity to get through to G2ZC on that low voltage.

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International Short-wave Radio League.

In our issues of July 30th and November 5th we drew attention to the International Short-wave Radio League which had been formed in U.S.A. primarily for the benefit of short-wave listeners, clubs and experimenters in all corners of the globe. The head offices of the society are at Jamaica Plain, Boston 30, Mass., and the European branch at 106, Lord Street, Southport.

We have received the first issue of the League's official publication, "The International Short-wave Radio News," a modest little 12-page monthly bulletin which we hope, in course of time, will increase in size and popularity, as it undoubtedly contains much information of interest to listeners. The first number gives a short account of the stations in Java, where short-wave working owes so much to the insight and enthusiasm of the late Dr. de Groot, who, it will be remembered, died while on his way to the International Radio Conference at Washington in 1927. Among other features is a useful list of stations regularly transmitting telephony on wavelengths from 11.55 to 104.5 metres.

The membership subscription to the League is $1 per annum, and this, of course, includes copies of the "International Short-wave Radio News."

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Short-wave Stations in Java.

The November Bulletin of the Radio Club of Ceylon also contains information relating to the stations in Java, so it will probably be of interest if we summarise the data collected from these two sources for the benefit of our readers.

The Government stations are :—

		Wavelength.	Power.
PLE	Bandoeng	15.93 metres	80 kW.
PLF	Malabar	16.80 ,,	40 ,,
PLR	Malabar	28.20 ,,	40 ,,
PLW	Malabar	36.92 ,,	80 ,,
PMB	Malabar	14.55 ,,	80 ,,
PMC	Tjimindi	16.52 ,,	60 ,,

PLE broadcasts every Tuesday from 13.40 to 15.40 G.M.T., and gramophone music is transmitted daily (Sundays and holidays excepted) from one or two of the above stations at 10.40 to 11.40 G.M.T.

In addition to the Government stations, various radio societies transmit regularly between 11.40 and 14.40 G.M.T. on powers varying from 0.3 to 1 kW., of which the following are the most active :—PMY, Bandoeng, on 58 metres; PK1AA, Weltevreden, on 75 metres; PK3AN, Sourabaya, on 49.7 metres; PK2AF, Djocjacarta, on 50 metres; PK6KZ, Macassar, Celebes, on 25.5 metres; and PK2AG, Samarang, on 95 metres. It is stated that the power of the societies' transmitters will be considerably increased within a short time.

TRANSMITTERS' NOTES.

New Call-signs and Changes of Address.

G2IH	Lensbury Radio Society, Shell Corner Kingsway, W.C.2.
G2TK	J. H. Wetherill, 30, Sculcoates Lane, Hull.
G2VZ	H. W. Daly, 73, Castleton Road, Goodmayes, Essex.
G2WA	F. W. J. Piggot, 180, Franciscan Road, London, S.W.17. (Change of address.)
G5AW	A. E. Wood, 102, Gracefield Gardens, Streatham, S.W.16.
G5JK	L. R. Harper, Seafield House, Aberdeen (returns to old address and relinquishes G2ZV, his portable station).
G6BU	(ex 2BQF), G. E. Bull, 64, Arthur Street, Ryde, I.O.W., transmitting on 14 mC. and will welcome reports.
G6GW	H. J. Gwillim, The Mount, West Hill, Tredegar, Mon.
2AAA	A. L. Crane, Hillside, 44, Brookbank Road, London, S.E.13.
2ACG	J. Oxley, 282, Easter Road, Leith.
2AMV	D. F. Waddington, 9, East Shrubbery, Redland, Bristol.
2AON	J. G. Openshaw, The Square, Haslingden, Rossendale, Lancs.

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TRADE NOTES.

Change of Address.

Geo. L. Scott and Co., Ltd., Morris House, 60-66, Rochester Row, London, S.W.1, have acquired larger premises at 86-88, Acre Lane, London, S.W.2. The telephone number is Brixton 6564.

R. O. Bridger and Co., 38, Goswell Road, London, E.C.1, manufacturers of "Grantona" cones, have moved into larger premises at 334, Goswell Road. The telephone number remains the same, viz., Clerkenwell 4415.

The Advertising Department of C. A. Vandervell and Co., Ltd., Acton, London, has been transferred to Birmingham, the address being Joseph Lucas, Ltd., Great King Street, Birmingham.

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Change of Name.

The business of Whiteley, Boneham and Co., Ltd., Nottingham Road, Mansfield, has been acquired by the Whiteley Electrical Radio Co., Ltd., as from October 31st, 1930. The address is unchanged.

CORRESPONDENCE

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

SERVICE AND THE RETAILER.

Sir,—With reference to your editorial on servicing, and recent letters by readers on the efficiency of the wireless salesman, I would like to define the service the wireless shopkeeper is expected to give. A friend has such a shop, and, incidentally, more than the usual amount of technical knowledge for such a shopkeeper. He tells me that it is the most worrying and trying business one can put one's hand to.

In selling other goods the shopkeeper, once he passes the goods over the counter, is paid for them and gets his retail profit and is finished with the matter, while the wireless salesman, when he sells a set, is only beginning his troubles, for he cannot leave a customer with no knowledge of wireless to carry a set home and connect it up. The customer simply can't do it, and expects the shopkeeper to send a man to do it *without extra charge*. Then in the thousand-and-one troubles that are always arising with a set—battery failing, atmospherics, loose connections, and so on, the customer wants the shopkeeper to send a man to see about it, and looks indignant if a charge is made.

The small man simply cannot give this service, and if he tries to give it after business hours he will find the worry out of all proportion to the profit, because he still gets only the small retail profit, similar to the retail profit on other goods.

To give only one instance. My friend sold a set, a D.C. five, with three of the valve filaments in series and two in parallel. The valves burnt out three times from causes not difficult to guess. My friend spent four evenings (about two hours each night) fixing it up. Then something else went wrong, and he decided to send the set back to the makers. The "customer" did *not* pay the carriage! The replacement set arrived in due course, and, after a fortnight's use, something went wrong, and after hours and hours of testing was localised to a break in one of the coils.

Imagine the worry and expense for the shopkeeper! And naturally he wanted to please the customer, and sell the set. If he had refused the service he could not have sold the set.

The only solution is for every wireless shop to have a skilled man in attendance, and charge for his time and trouble—just as a hardware shop would charge for sending the plumber.

S. Wales. WM. J. LEVER.

BROADCASTING GRAMOPHONE RECORDS.

Sir,—As one who has been very fond of "Wireless" for a considerable time I was very pleased to see the letter you published from Mr. Ernest W. Dunn on November 5th.

As Mr. Dunn explains, the great pleasure in "Wireless" lies in the knowledge that one is listening to the actual performance. If you find that the practice of introducing gramophone records grows to any great extent, it will bring about a serious decrease in the number of licence holders. I for one, after being very enthusiastic, would lose all interest in the "Wireless."

Burnham, Bucks. H. R. CHESTNEY.

RECEPTION IN CORNWALL.

Sir,—"Free Grid," in your issue dated October 29th, 1930, asks for comments on broadcast service in Cornwall. It is diabolical!

I entirely agree that 5XX is the only British station of any entertainment value in these parts, and during the past six months even this station cannot be entirely relied upon. During light hours reception is fairly consistent, during dark hours fading takes place, the value of the wave diminishing to approximately 20 per cent. of its normal day-time value. The total period of fading being from 20 to 40 minutes at a stretch. These measurements were noted by means of a milliammeter in the anode circuit of the anode rectifier of the "New Kilo Mag Four" receiver.

Both the Brookmans Park stations "come in" with a strength comparable to (if not sometimes greater than) 5XX, but fading and Morse interference render them quite impossible from an entertainment point of view. "Wireless hardships" in Cornwall are not only concerned with reception difficulties, the county is, unfortunately, supplied with 25 cycles A.C. mains.

From nearly every point of view I think "The Yachtman's Three" meets the needs of the average Cornish listener. I have recently built a similar receiver; I say similar since slight modifications such as anode bend rectification, a 3 : 1 ratio transformer, etc., were made. I find on 50 feet of aerial, about 30 feet high, and 12 miles from Land's End, with 5XX I can fully load the rectifier—a P.M.2D.X. biased to 10½ volts.

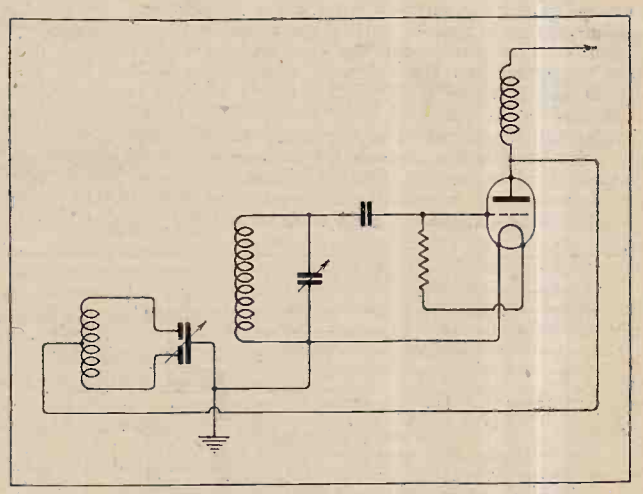
It would be very interesting to hear whether any other reader has noted the unique advantages of this receiver for outlying districts such as these. G. S. GARDINER.

Zennor, near St. Ives, Cornwall.

VOLUME CONTROL AND FADING.

Sir,—Those readers who have tried out the anti-fading device described in a recent issue of this Journal will, probably, have been surprised that so simple a scheme should be so effective.

It is here proposed to describe a method of volume control which brings the anti-fading device into play automatically without the use of a switch. The circuit diagram is shown in the figure:—



The circuit arrangement described.

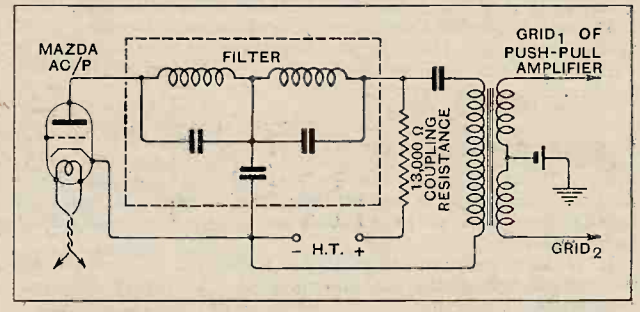
A differential reaction condenser is used in conjunction with a centre tapped reaction coil. The centre tap is connected to the anode of the detector valve, and each end of the coil to one set of fixed plates on the reaction condenser, the moving plates being connected to earth.

It was explained in the article referred to above that the effects of fading are at their worst when reaction is being used. Reducing the amount of reaction tends to lessen the effects of fading, reversing the reaction tends to compensate for them. If, then, the method shown in the figure is used and the volume brought to the desired level by means of the reaction condenser, it seems likely that we are getting as little fading as possible from the station being received. If the

signal is strong enough to require drastic volume control the reverse reaction effect will take place and tend to counteract fading. Two or more H.F. stages are desirable for use with this system, partly because amplification to bring the fade periods up to the desired strength is required, and also because the increase in the effective resistance of the tuned circuit which accompanies reversed reaction makes it desirable to obtain selectivity elsewhere. H. B. WARD.

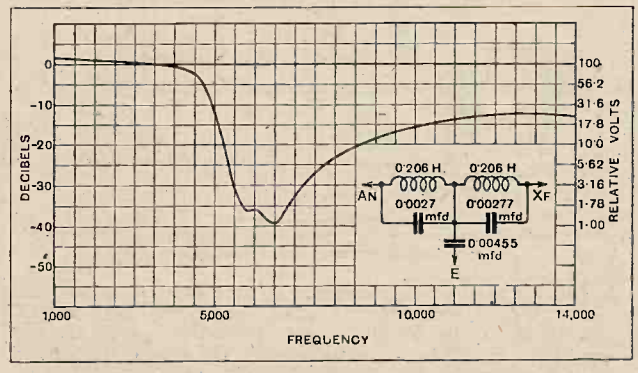
WHISTLE INTERFERENCE.

Sir,—The interesting letter from your correspondent, "W. S.," in the October 22nd issue, has prompted me to write you on a similar subject. My new set (with 44-watt output stage) reproduces frequencies up to 14,000 cycles, and since its inception I have been seriously troubled with "whistle interference" on the three main stations' programmes. The frequency of the whistle varies between 9,000 and 11,000 cycles, and I have successfully used an audio frequency band pass filter to eliminate the trouble. The effect on the transmission is not noticeable, except on the sibilants of some of the speech, and, as there are no adjustments to make once the filter is fitted, it is probable that a description of the make-up of the apparatus may be of interest to other readers. A similar filter,



Circuit of filter introduced to eliminate high note whistle.

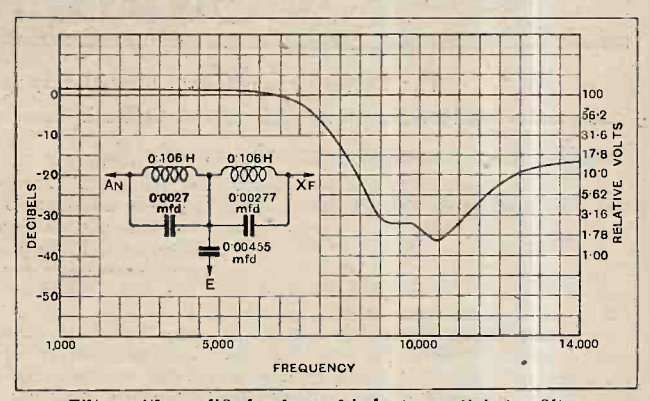
using the same condensers with larger inductances, is used for reducing needle scratch during the reproduction of gramophone records. Loss curves for the two filters are shown, but it is not suggested that the values of components are the best that could be used, and it is possible that a sharper bend could be obtained in the curve of the "radio" filter by a better choice of L and C values. The condenser values shown are actual measured capacities, and are the nearest to the desired values, which could be readily obtained. The inductances are air core coils, wound on a cylindrical former 2in. dia. 13-16in. axial length. The 0.106 henry coils each have 1,200 turns of various



Inductance and capacity values and the characteristic of the filter product.

sizes of wire (short pieces being used for purposes of economy) wound to an outside diameter of 3in. The 0.260 henry coils, each have 1,910 turns of wire, wound on the same former, to an outside diameter of 3½in. (The size of wire varies between 26 g. enam. and 34 g. D.S.C.)

The coils were immersed in hot beeswax, before tapping, to preserve the insulation, as this was found to cause a lower loss (i.e., increase of A.C. resistance) than shellac impregnation. The curves shown are plotted to a logarithmic loss scale, i.e.,



Filter with modified values of inductance giving a filter peaking at about 10,000 cycles.

in decibels, but the relative voltages at the output of the amplifier with which the filters were tested are also given.

In actual use the filters are as shown in the accompanying circuit the AC/P valve (which follows the detector) feeds the push-pull stage, consisting of four LS5A valves.

Although I have developed the filters successfully, the credit (if any) for the idea should go to a friend (Mr. Walsh, of the Standard Telephones and Cables Co., Ltd.), whose musical ear was offended by the annoying whistle, frequency approximately 9,500 cycles, which accompanied a transmission from the London Regional Station. Yours faithfully,

T. S. SKEET.

QUALITY RECEPTION.

Sir,—I should like to point out an inexactitude in the columns of your journal.

Mr. John Harmon, discussing "Quality Reception," at the bottom of column 2 on page 415, October 8th issue, writes :—

". . . The direction in which the needle first moves at the beginning of a flicker indicates the state of the grid bias; if the bias is insufficient . . . the average current decreases." He states also that the converse is true.

Superficially this appears to be correct, and, indeed, is so if the loud speaker impedance does not vary with frequency and has the optimum value.

In practice, however, the speaker impedance does change with change of frequency. For a moving coil speaker this variation of impedance as compared with the variation in the case of a speaker of the balanced armature type is small enough to be neglected.

If the impedance of a moving-coil speaker is higher than the optimum value (i.e., if AB in Fig. 15 is turned anti-clockwise) and the operating point remains the same we see from the figure that a signal of sufficient intensity will cause a downward kick, or if the speaker impedance is too low, an upward kick.

Thus, although the bias is optimum, kicks may occur in either direction according as the speaker impedance is high or low.

With a moving-iron speaker the impedance rises as the frequency rises; if, as is usual in well-designed sets, a suitable ratio of output transformer is used to make the effective speaker impedance optimum at about 200 p.p.s, then a powerful note of low frequency will cause an upward kick (the speaker impedance being lower) while one of high frequency will cause a downward kick, corresponding to a high L.S. impedance. This, of course, takes place equally with optimum grid bias.

The truth of this is easily shown experimentally by owners of low resistance moving-coil speakers. If the coil is wound to the optimum value, a small resistance in series with it will produce downwards kicks, while one in paralled will produce upward kicks.

This, in my opinion, constitutes a theoretical argument in favour of the moving-coil speaker as against the moving-iron, which is not sufficiently emphasised.

London, N.4. CHAS. F. BROCKELSBY.

READERS' PROBLEMS ANSWERED

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

When Reaction may Improve Quality.

Although it is commonly found that excessive use of reaction brings about a noticeable deterioration of quality, I find that this does not happen with my new three-valve set; reproduction is in no way impaired—it seems to be actually improved—by adjusting reaction so that the detector valve is very close to the point of self-oscillation. The set includes a band-pass input filter with ganged control, and a separately tuned "parallel feed" H.F. stage, followed by a reacting grid detector.

As this effect is entirely contrary to my usual experience, I should like to know if there is an explanation for it. R. P. R.

It is by no means unusual to find that a set such as you describe can be operated satisfactorily (from the point of view of quality) when considerable use of reaction is made; this is one of the advantages of a set with an input filter. When it is observed that the application of what would generally be regarded as excessive reaction does not impair quality, it will generally be found that the resonance peaks of the input filter are more clearly defined than usual, and that, in consequence, the higher modulation frequencies are over-emphasised at the expense of the lower frequencies. By applying reaction between the detector plate and grid circuits the balance may be restored, as the high frequencies will then be attenuated in the tuned intervalve circuit.

o o o o

The "Band-pass Superheterodyne."

As I live at a considerable distance from any transmitting station, and consequently do not stand in need of a particularly selective receiver, I am wondering whether it would be better to modify the "Band-Pass Superheterodyne" (which I am thinking of constructing) so that a full-sized outside aerial may be used instead of a frame. If you agree that this would be an advantage where extreme sensitivity is desired, I should be obliged if you would indicate the modifications. T. L.

We would strongly dissuade you from modifying the receiver in this way, as we are sure that a centre-tapped frame aerial as specified is the most satisfactory form of collector to use with this receiver. The use of an outside aerial would give rise to an extremely noisy background under ordinary atmospheric conditions. It would seldom be possible to take advantage of increased sensitivity. It must be remembered that the directional properties of a frame aerial are most valuable when operating a highly sensitive receiver of this sort, particularly with regard to the elimination of Morse, C.W. "mush," and interference from power circuits, which is not "tunable" in the ordinary sense.

o o o o

The "Power Pentode Two."

I should like to adapt my "Power Pentode Two" receiver for gramophone reproduction, and to obtain automatic negative bias for the present detector valve when it is converted to operate as an L.F. amplifier. If the necessary alterations can be effected in a very simple manner and without the use of non-standard components, so much the better. N. L. E.

The simplest way of introducing the desired modifications is shown in Fig. 1, from which you will see that the necessary bias resistance of 500 ohms is inserted in the cathode lead.

In order that the first valve may work with a zero grid when functioning as a detector, it will be necessary to change over the connection of the grid return lead to the tuned circuit, which must no longer be joined to the earth bus-bar, but directly to the cathode.

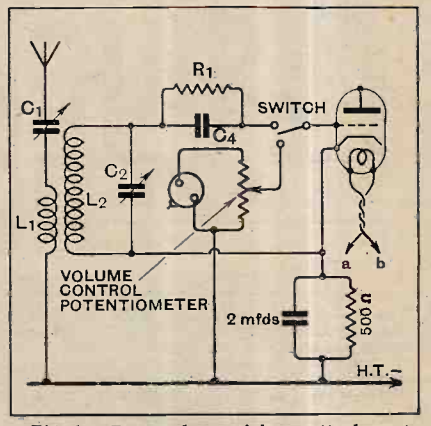


Fig. 1.—Gramophone pick-up attachment for the "Power Pentode Two."

o o o o

An Unattractive Set.

I am thinking of making up a set similar to the "Regional One" ("The Wireless World," August 13th), but, as mains are not available, I intend to use a 2-volt battery-heated pentode. Would this be satisfactory? P. W.

We can hardly recommend an arrangement of this sort, except when a super-power pentode with characteristics closely resembling that of the valve originally specified is used. It must not be forgotten that, by making a pentode serve the dual functions of detector and output valve, its power output is reduced by something in the order of 75 per cent.; even if you choose the most ambitious 2-volt pentode on the market, it is unlikely that you will succeed in obtaining an L.F. output of as much as 150 milliwatts. This is less than could be obtained from an ordinary L.F. stage with a much more economical valve—from the point of view of anode current consumption.

It can generally be assumed that a single-valve loud speaker set of this kind is practicable only when it is fed from the mains.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

Resistance of Connecting Leads.

I believe that the resistance of copper wire is increased when it is coated with tin; if this is so, would it not be better to use bare wire for the internal connections of a receiver?

S. C.

Although the resistance of copper wire is increased by "tinning," this increase is not appreciable except when dealing with ultra-short wavelengths. Over the usual bands of frequencies no advantage would be gained by using uncoated wire, which is more difficult to solder.

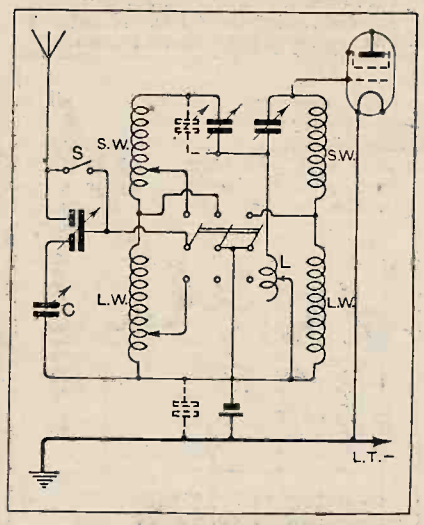


Fig. 2.—A band-pass filter with variable inductive coupling; the differential aerial input control may be short-circuited by the switch S. C, aerial capacity balancing condenser; L, coupling inductance; S.W., short-wave coils; L.W., long-wave coils.

An Inductively Coupled Filter.

In the interests of economy I propose to use inductive coupling in a band-pass input filter. It is intended that wave-range switching shall be included, as both medium and long broadcasting wavebands are to be covered.

In order to get the best possible results, and to obtain a certain measure of flexibility in operation, I should prefer to use a variable coupling inductance consisting of a tapped coil, provided that you see no objection to this course, and would also like to fit a differential input volume control condenser with a balancing capacity (as described in your journal), so that tuning may be affected as little as possible. At the same time it would seem as well to fit a switch to cut out the volume control condenser, so that maximum sensitivity may be obtained when necessary.

C. B. L.

An input filter on the lines you suggest should give very satisfactory results. The use of an inductance for coupling purposes is likely to prove economical, as a number of large condensers would be necessary if a wide variation of coupling is to be obtained by the capacity method.

The diagram of a suitable circuit arrangement is given in Fig. 2. The simplest way of cutting out the volume control condenser is to connect a switch (marked S in the diagram) as shown: it must be remembered that the closing of this switch will increase the amount of transferred aerial capacity, and will bring about the need for some readjustment of tuning. This can most conveniently be allowed for by fitting a trimming condenser, which is indicated in dotted lines. It would be as well to shunt the grid-bias cell by a large condenser, but, as this is optional, its connections are shown in the same way. This inductively coupled input filter cannot form part of a one-dial operated set embodying H.F. amplifying stages.

oooo

An Indifferent L.F. Transformer.

A rather out-of-date L.F. transformer is at present being used in my H.F.-det.-L.F. set, and I am thinking of replacing it by a more modern component of the best type. Will you tell me what are the most obvious advantages likely to be gained by doing so? I refer, of course, to improvements in reproduction likely to be aurally appreciable.

H. C. L.

An indifferent L.F. transformer is always deficient with regard to the lower audible frequencies, and as often as not it exhibits a marked falling-off in passing on extremely high frequencies. Consequently, the middle frequencies, generally in the order of 1,000 cycles, are over-emphasised by the receiver, and, incidentally, as a rule, by the loud speaker as well. The resulting reproduction, consisting mainly of a narrow band of frequencies, has deficiencies that are painfully evident even to a non-musical ear.

An up-to-date transformer of good design should give substantially equal amplification to both high and low frequencies.

oooo

Frame Aerials and Instability.

Will you tell me if it is correct to assume that a frame aerial can be used in conjunction with any modern set having one or more H.F. stages merely by substituting the frame for whatever coil may be shunted across the grid circuit of the first valve? It is realised that the "pick-up" of a frame is much less than that of an open aerial, and in consequence that the substitution of this form of collector would only yield good results in the case of a highly sensitive set.

R. M.

With regard to the ordinary "H.F." receiver of typical design, it would be unwise to assume that a frame aerial could always be satisfactorily substituted for the normal aerial in the manner you describe—or, indeed, in any other way. Unless the frame is mounted at such a distance from the receiver that the self-capacity of the connecting lead becomes inconveniently large, there is always a risk that undesirable magnetic coupling will take place between the frame itself and the anode coils of the receiver. Of course, if the anode coils are completely shielded, this trouble should not arise.

Pentode Output for the "All-D.C. 3."

Will you please tell me what circuit alterations should be made to the "All-D.C. Three" ("The Wireless World," August 20th, 1930) to enable me to use an Osram P.T.625 pentode valve in the output stage?

J. McA.

Apart from providing an H.T. feed lead for the screening grid, the only modification necessary is in the output grid circuit; the P.T.625 requires rather less negative bias than the valve originally specified.

The grid bias resistance R_7 may be wound as described in the constructional article, but a tapped connection should be made at the 60th turn of the winding, counting from the end that is joined to the output valve filament. Instead of wiring the L.F. transformer secondary to the junction between R_7 and R_{10} it should be connected to this tap.

oooo

Winding a Power Transformer.

I have studied several of your articles dealing with the construction of power transformers, but am still uncertain with regard to one detail. When a "layer" winding is specified, is it correct that, after having finished the first layer, the wire should be bent so that the second layer may start from the same end?

J. M. O'D.

This procedure is quite unnecessary; indeed, to do as you propose would increase the space occupied by the winding to an appreciable extent.

When making a coil of regular layer formation it is usual to wind in such a way that the first turn of the second layer is immediately above the last turn of the first layer, and so on.

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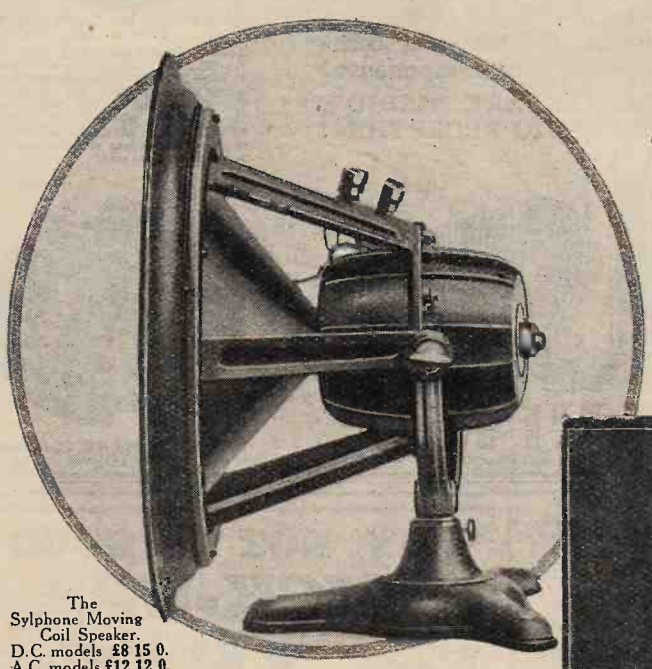

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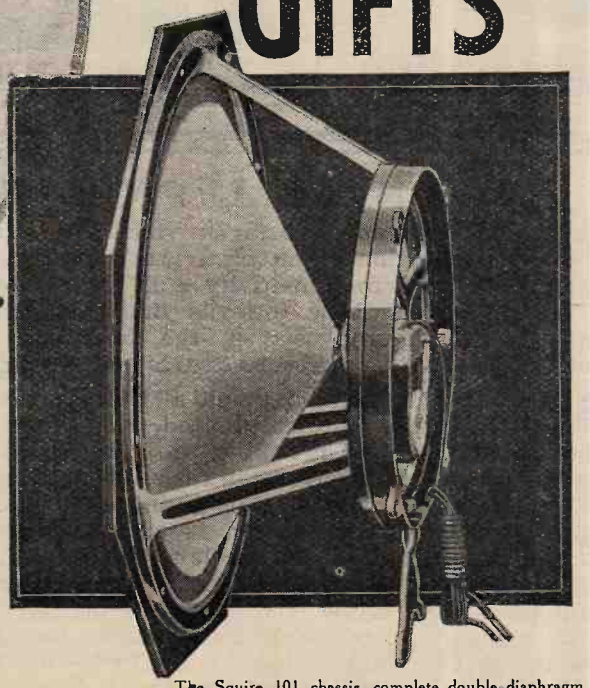

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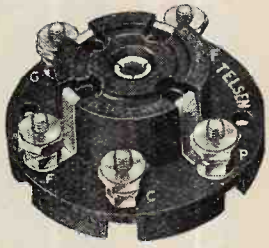

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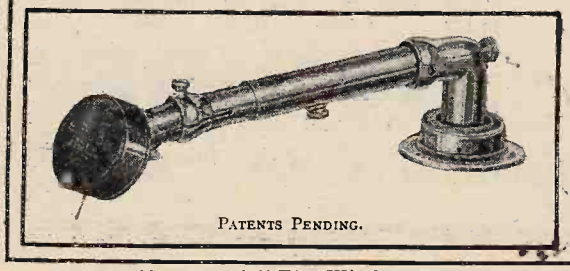

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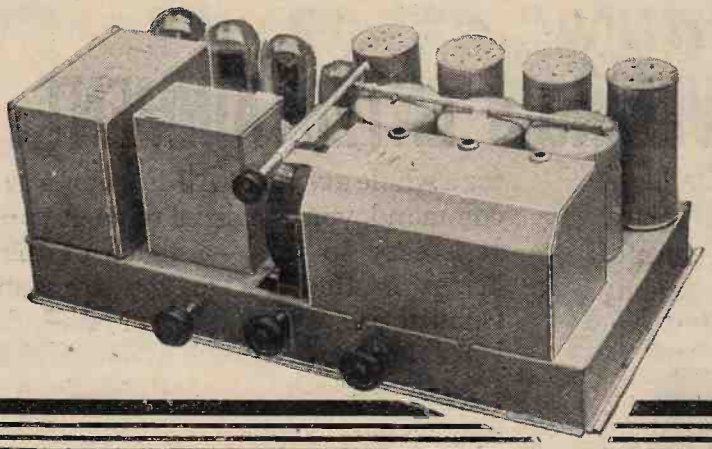

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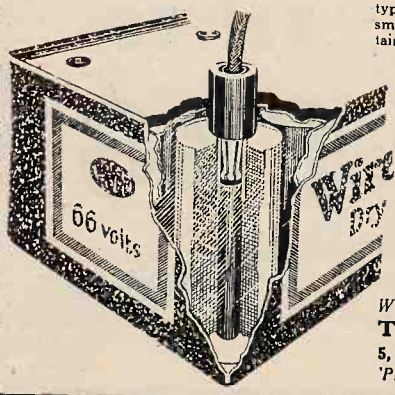
THE NEW POSITIVE GRIP WANDER PLUG. Ideal for portable sets and where space is limited. Various colours. Price **2d.** each.

POSITIVE GRIP SPADE END. Acid-proof contacts at all times. Price **3d.** ea.

POSITIVE GRIP Banana Type PLUG & SOCKET. A great advance on all other types of plug. A silky, dead smooth contact is NOW obtainable. Price **4d.** complete.



THE POINT—

of the new Lisenin Wander Plug overcomes all contact troubles. The patented construction effectively prevents "wobbling" in the socket. It makes perfect electrical and mechanical contact and does **not** require constant opening of the prongs.
Price **2d.** each.

We have moved to larger premises. Note new address:—
THE LISENIN WIRELESS CO.,
5, Central Buildings, HIGH ST., SLOUGH, Bucks.
'Phone : Slough 652. T. Address : POSGRIP SLOUGH.

Look for the Lisenin Show Case on your Radio Dealer's Counter.

CHRISTMAS GIFTS

GREEN Condensers are SAFE!

IT does not pay to take chances in buying condensers. Remember, they may *look* efficient, yet, just as a smiling face may hide a harsh nature, so a well-finished condenser case may mask an inefficient interior. But there is a safeguard. *If it has a green case, you are safe in buying it.* For then it is a T.C.C. Condenser.

The green case of a T.C.C. Condenser is a symbol of safety. Inside it is a quarter century's experience in condenser manufacture. Experts know this —and choose T.C.C. "The Wireless World" knows it—and invariably uses T.C.C. Condensers in its sets. You are safe in following its lead.

The new types illustrated above are (left to right): T.C.C. 4 mf. Paper type, 6/3; T.C.C. .01 Mica Flat type, 3/-; T.C.C. Mica Upright type, 1/6; T.C.C. 2 mf. Paper type, 3/10; T.C.C. Electrolytic type, 15/-. Ask your Dealer for complete price list.

T.C.C. CONDENSERS

IN THE GREEN CASE

Advt. Telegraph Condenser Co., Ltd., Wales Farm Rd., N. Acton, W.3.

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VOLUTE PLIERS

PRECISION WIRE LOOP FORMING TOOL

Reg. Des. No. 753447 Pat. Pen. 10914/30

To Amateur and Expert Wireless Set Constructors.

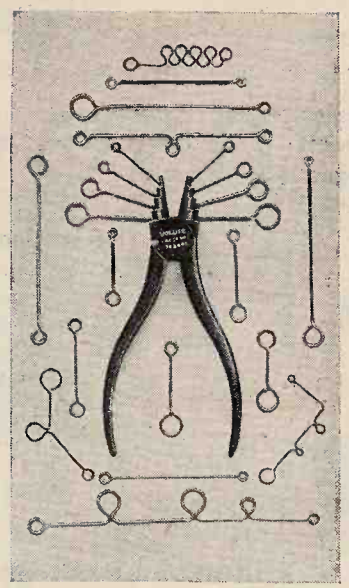
Why not an efficient wiring system in your Sets, with perfect loops in your wires, giving a perfect contact throughout its circumference, with greater efficiency in results.

Every loop of correct form and dimension in one operation, in a fraction of a minute. No guessing or resetting as in the old method.

Easy of manipulation, with accurate results, a great saving in time, whether employed by the amateur or expert.

Loops a good fit, easily adjusted to terminals, screws, and other connecting devices used in electrical apparatus.

Full instructions issued special to Wireless Set Constructors, with each Tool.



Entirely British in design and manufacture, they are invaluable to everyone associated with the Wireless, Electrical, and kindred trades. Made of the best tool steel, hardened and tempered in oil. Eight gauges on one tool, ensuring neat and accurate loops in one operation, in a fraction of a minute. Wire cropper incorporated in circular joint.

Price 4/- each.

If unobtainable at your local dealer, send remittance to the Company direct:—

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19, Victoria Square, London, S.W.1
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Telegrams: Pliaspiral Sowest London.

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Colassion Super Loudspeakers

Guaranteed FIVE YEARS

Precision Instruments, not mass productions.

Handles faithfully all sound waves!

COLASSION SUPER LOUDSPEAKERS embody entirely new principles. The reed (which is covered by world-wide patents) used in conjunction with a correctly designed diaphragm mounted on sorbo rubber sponge will handle the output from any size amplifier, without chatter, with a purity of tone and perfection of balance, yet to be equalled. With a 6 watts amplifier these speakers will fill a hall of 800 seats capacity. So sensitive is the movement that even our Cinema Models have been driven from a Crystal Set. This is no exaggeration. It is a fact! We invite you to call for a demonstration and comparison with a Moving Coil Loudspeaker. Specially recommended for "The Wireless World" Four.

COLASSION SUPER STANDARD of solid well-seasoned selected Oak. High-grade finish which will retain its appearance permanently. Size 19¾" x 19¾" x 10¼" x ¾" thick.

Model No. 1, £7:10:0. Model No. 2, £10:0:0.
COLASSION STANDARD, £5:0:0.

SUPER COLASSION PEDESTAL DE LUXE. Built of best quality mahogany with quartered panels. It is of most attractive design and exquisitively finished. 39½" high, 22¾" wide, 13½" back to front.

£15:0:0

14 DAYS' APPROVAL.—If you are not entirely satisfied return the instrument undamaged within 14 days and the purchase price will be refunded in full immediately.

See your local dealer—if he is out of stock write direct or call:—

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Mark Lane Station Buildings,
London - - - E.C.3.
'Phone: Royal 2860

Give your set a Tungar this Xmas . .

BATTERY CHARGER

You'll never be "let down" in the middle of a programme if you instal a TUNGAR Trickle Charger. For a negligible cost per day the TUNGAR keeps your L.T. Accumulator fully charged. When you switch off your set, switch on the TUNGAR and your accumulator will be gently recharged. No disconnections or connections to make, just switch on—that's all. TUNGAR gives a continuous output of 0.3 ampere and charges 2, 4 or 6-volt accumulators.

Another TUNGAR, from which you can charge both High and Low Tension Batteries, sells for 72/6d. Your dealer can supply you.

FOR A.C. MAINS ONLY - - PRICE **35/-**

EDISWAN

Advt. of The Edison Swan Electric Co., Ltd.
Incorporating the Wiring Supplies, Lighting Engineering, Refrigeration and Radio Business of the British Thomson-Houston Co., Ltd.

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35 STATIONS GUARANTEED
UNDER AVERAGE CONDITIONS!

SCREENED GRID 8
RADIO GRAMOPHONE

An All-electric Radio Gramophone for 100-120 volts & 200-250 volts, A.C., 40-60 Cycles.
3 screened grid valves, power detector and two stages of L.F. amplification with two super power valves in the output stage. A full wave valve rectifier is employed which as well as supplying the high tension current supplies the field winding of the energised moving coil speaker. Three tuned circuits are used, these being controlled by one dial which is illuminated. Wavelengths 200-600 and 1,000-2,000 metres wave change being effected by control on panel.
A BTH pick-up and silent running induction-disc motor are employed.
Pre detector volume control is used on the radio with a separate control for volume on gramophone.
Volume and range are remarkable; over 40 stations have been tuned in within eight miles of London, while London was working, at full loudspeaker strength.
Selectivity is also astonishing. Toulouse, for example, can be tuned in at full volume without a trace of London Regional (6 miles away) even on a long outdoor aerial.
Supplied in beautiful finished Oak, Mahogany or Walnut Cabinets. Sizes 36" high, 2' wide, 20" deep.

OAK	MAHOGANY	WALNUT
39gns.	**42gns.**	**45gns.**

Delivered on the 1st of 24 monthly payments of

37/7	**40/5**	**43/6**

12 months written guarantee supplied with each instrument. ALL ROYALTIES PAID. If you live in the London area we can arrange demonstration. Radio model only available if required

WRITE FOR DESCRIPTIVE PAMPHLET

THIS LETTER FROM A VERY SATISFIED OWNER OF ONE OF THESE REMARKABLE RECEIVERS SPEAKS FOR ITSELF:

CATFORD, S.E.6

"I happen to be a possessor of one of your Bon Marche Screen Grid Eight Radio Gramophones, and feel I must write and let you know how very satisfied and proud I am of my set. Its reception is little short of marvellous and the tone, almost a perfect reproduction. Although I have only had the set just about 3 weeks I have already found and logged 53 stations including Schenectady, U.S.A. and the British relay stations Cardiff, Bournemouth, Manchester and Glasgow. The reception from Moscow T.U. 75 kw so surprised me, that I was immensely puzzled, I heard a person speaking in perfect English from just above Kalundborg and for curiosity waited until he had finished, and found that it was a person from Moscow T.U. 1103 m. giving English Market prices in perfect English. You are quite at liberty to show this letter to any of your customers or bring them along here for a demonstration if you like. Thanking you once again for the Demonstration that induced me to be possessor of this remarkable set."

THE ORIGINAL OF THIS LETTER AND OTHERS MAY BE SEEN AT THE BON MARCHE

BON MARCHÉ LTD
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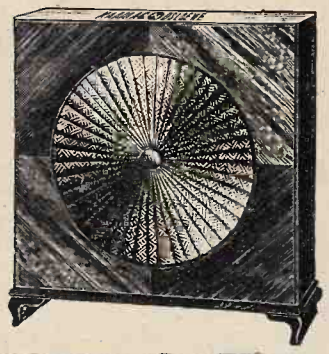
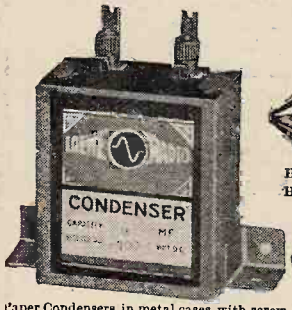
"The Pick of the Bunch"

Receiver R.O. 433, 70/- complete, as shown. The One-valve Set with the Three-valve Power.



4-pole Speaker E.B.85, 42/-. The Outstanding success of The National Radio Exhibition. 4-pole Loud-speaker Unit and Chassis, LCH 85, 16/6. Unit only, LS 85, 12/-



High Vacuum Resistances - - - 1/6
High Vacuum Condensers - 1/- and 1/3

Paper Condensers in metal cases with screw Terminals, Solder Tags and Fixing Lugs. (For Horizontal or Vertical Mounting). Prices on request.

Gramophone Pick-up L.R. 92 - - 15/-

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for CHRISTMAS —

MAINS UNITS

Incorporating Westinghouse Rectifier.

H.T. *from* £2.17.6

H.T. & L.T. Combined £5.10.0

RECEIVERS 2, 3 & 4 VALVE

"ALL-ELECTRIC" NO BATTERIES COMPLETE *from* 10 gns.

"ALL-ELECTRIC" RADIO-GRAMS

Not massed produced, but individually built — M.C. Speaker, Slow Speed Induction Motor, etc. Demonstrations given all over the country.

Price *from* 45 gns.

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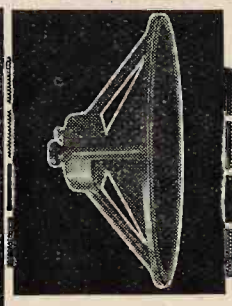

THE ONLY LOUD SPEAKER WITH A REINFORCED DIAPHRAGM

CELESTION CHASSIS D. 20

A complete loud-speaker ready to be mounted in your portable, radio-gramophone or baffle

£3 : 3 : 0

Rigidity and lightness have always been the aims of every loud-speaker manufacturer but only Celestion holds the World's right to produce the unique Celestion *reinforced* diaphragm. No other diaphragm so successfully combines lightness with rigidity. From no other diaphragm can you expect such faithful reproduction. For lifelike beauty of tone IT MUST BE CELESTION.

Send for illustrated lists showing full range of Celestion models.

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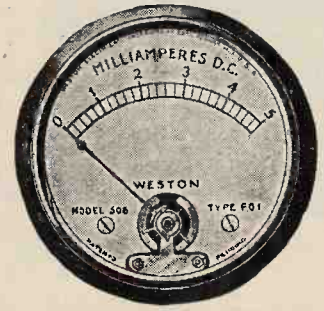

TO TRACE DISTORTION

It requires the accuracy and sensitivity of a Weston Mil-Ammeter to tell you exactly at which particular stage in your receiver distortion begins.

Try it in your H.T. leads in turn. Should the needle kick strongly either backwards or forwards when signal strength varies, it indicates transformer distortion, over-saturation of the valve, incorrect grid bias, filament temperature or H.T. Potential.

A Weston Mil-Ammeter is the only instrument sufficiently accurate to be of any value to you when making readings. Weston Instruments are standard the world over, and since 1888 have been unrivalled for scientific precision, uniform accuracy and unvarying reliability.

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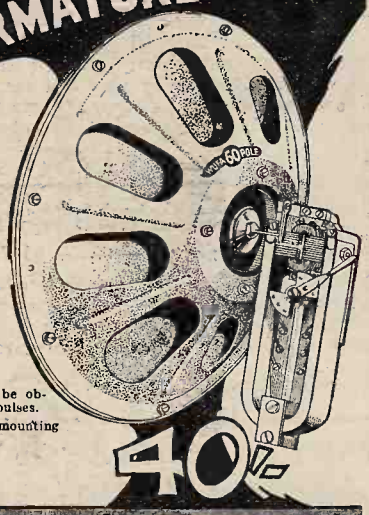
WUFA 60 POLE SUPER-POWER BALANCED ARMATURE UNIT



Made of finest material throughout. A real wonder for pure and powerful reproduction.

The efficiency of this unit is the highest of its class and compares most favourably with many well-known Mains driven Units.

PRINCIPAL CHARACTERISTICS:

A large and most powerful magnet.

60 well-insulated, separated poles.

Three alternative resistances, 1750-1200 and 500 ohms.

Reed indirectly driven.

Adjustment enables finest results to be obtained on the most weak or strong impulses.

Fixing plates for a variety of mounting positions.

Diameter of Cone 15".

Supplied complete on Solidly Built Chassis.

40/-

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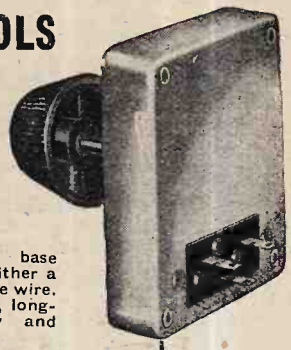

The new Electrad Super Tonatrol variable non-inductive high resistances will safely dissipate 5 watts at any position of the contact with one-tenth or more of the resistance element in circuit. The all-metal construction with the graphite resistance element fused to an enamel base obviates the necessity of using either a low-current paper element or fine wire. The action is amazingly smooth, long-lived, and both mechanically and electrically perfect.

The Super Tonatrol embodies new ELECTRAD ideas of proved merit with generous factors of safety. More than ten years of average service find the Super Tonatrol performing with no appreciable wear or change in resistance rating.

No.		Each
1.	25,000-ohm potentiometer	8/6
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Reduce Your H.T. Running Cost 80%

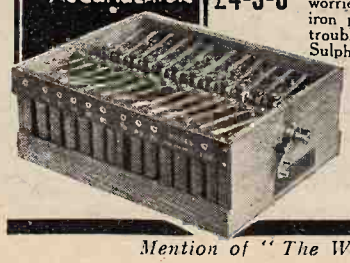
PROVED AND TESTED

BY TAKING IT FROM THE L.T. ACCUMULATOR—

MILNES H.T. SUPPLY UNIT

See Editorial Report—WIRELESS WORLD, Oct. 22nd, 1930.

HIGH-TENSION IS FED AUTOMATICALLY FROM THE LOW-TENSION ACCUMULATOR



120 Volts Unit £4-5-0

MANY TESTIMONIALS—

THE Unit consists of indestructible nickel iron cells which are kept charged automatically from the L.T. accumulator—by means of a series-parallel switch—thus supplying a steady and ample stream of H.T. Current. The L.T. Accumulator will require very little more charging than formerly. It seems too good to be true—but nevertheless, it is. Absolutely abolishes H.T. worries. The "Alklum" nickel and iron plates are entirely free from the trouble customary with lead plates. Sulphation is impossible, and cells cannot be damaged by any rate of charge or discharge. Will supply 40 milli-amps per hour.

Write To-Day for Full Particulars:—
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Cottingley Bridge,
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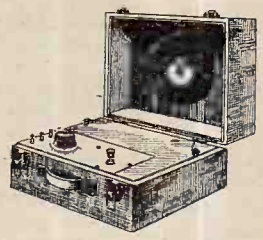
'Phone: Bingley 500.

SOMETHING NEW FOR XMAS!



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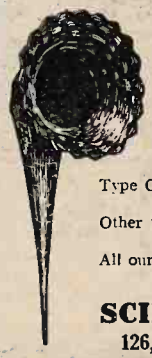
The "Scientific" 3-valve Gramophone Amplifier with Volume-Control, as illustrated, is an ideal entertainment provider, giving amazing volume and purity. For use in the home, public, or private entertainments. Any good Loudspeaker can be used.

Kit of Parts for home assembly, with instructions (Carriage Paid) **£2 - 9 - 6**

Built, ready for use (Carriage Paid) **£2 - 19 - 6**

(Without Valves and Batteries).



With the above Amplifier, or at all times when undistorted reproduction is essential, use one of the **"SCIENTIFIC" EXPONENTIAL HORNS.** When fitted to any good unit, such as the "Brown" U/GA, these non-metallic sound-amplifiers provide the most efficient and faithful method of reproducing speech and music.

Type C635 (as shown), 5 ft. high, 25 in. mouth (Carriage Forward) **19/6**

Other types, straight and folded .. .. from (Carriage Forward) **7/9**

All our goods are fully serviced and guaranteed.

List and advice free.

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SOLVES THE D·C TO A·C PROBLEM

ML

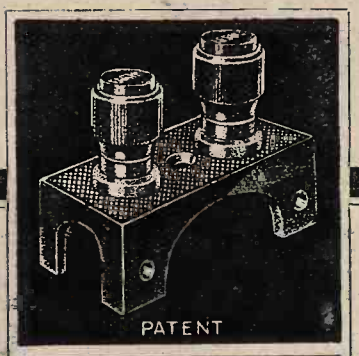
D.C. to A.C.
ROTARY TRANSFORMER

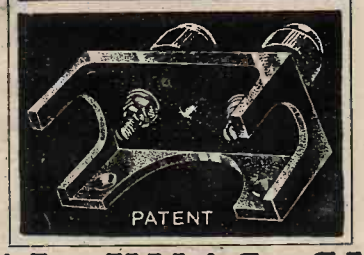
D.C. mains need not prevent your using an A.C. All Electric Receiver. Use an M-L D.C. to A.C. Rotary Transformer and operate your set from mains, private house plant or L.T. Accumulator. Can be supplied to run from any voltage 12-250 V.D.C. 40 watt model £13; 85 watt model £17. Write to-day for "The Book of the M-L Rotary Transformer."

THE M-L MAGNETO SYND. LTD., Radio Dept. B, COVENTRY. Telephone: 5001. Contractors to the Air Ministry, the B.B.C., the G.P.O., Marconiphone, The Gramophone Co. Ltd., etc., etc.

Godbolds

FOR YOUR OWN SET —OR YOUR FRIEND'S





IDEAL XMAS GIFTS

Make sure your set is working at its best for Xmas. Write for the **free** Belling-Lee Handbook "Radio-Connections" (2nd Edition). Full of interesting information, it suggests many novel uses for Belling-Lee Products, either for adding to an existing set or building into a new one.

Belling-Lee Radio Connections are the last word in safety, efficiency and reliability. Unique in design, they can never come adrift and they add to the appearance of any set.

Remember your friends when you are looking through the free Handbook. Belling-Lee Battery Cords, Spadensers, Wanderfuses, etc., make excellent gifts.

The Belling-Lee Bakelite Terminal Mount (*as illustrated*)	8d.
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Belling-Lee Terminals—	
Type "B"	6d.
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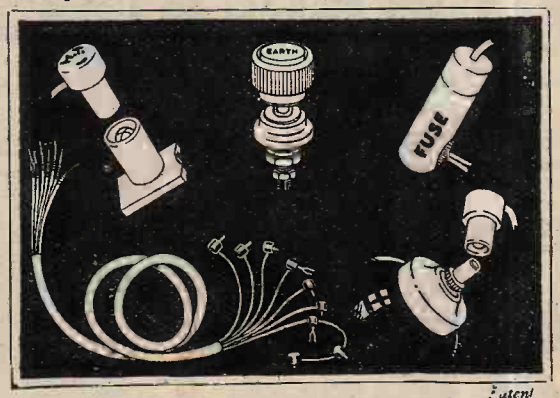
Battery Cords, 9-way	5/9d.
Also made in 5, 6, 7, 8, and 10-way.	
The New Wanderfuse	1/6d.
(*Spare Fuses* (150 *m/a*) 9d. *each*).	



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FOR EVERY RADIO CONNECTION

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TESTS EVERYTHING

THE GREATEST ADVANCE IN RADIO SINCE MARCONI

12/6

provides the most useful Xmas present it is possible to buy.

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Obtainable from all good Wireless Dealers.

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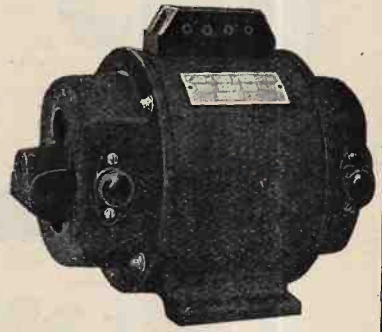
D.C. to A.C. ROTARY TRANSFORMERS FOR RADIO

SIZES FROM 40 - 500 WATTS



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NOTICE

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is used all over the World. It is reliable and British made. Low Loss Formers and Panels a Speciality. Made by Experts.

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Sole Makers:—
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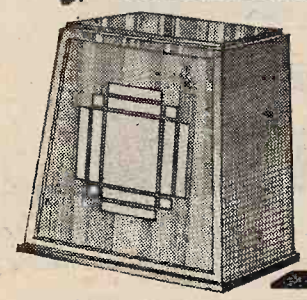
Put your Speaker in a Cabinet of Distinction!



SCIENTIFICALLY DESIGNED to give the best acoustic results.
In polished oak £1 : 1 : 0
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Height, 14½ *ins.* *Width*, 13½ *ins.*
Depth, 7½ *ins.*

Write for our Lists of new Radio and Gramophone Specialities.

GEO. BLAKEY & SON LTD.
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Telephone: 2518.

Our X'mas Gift to you

Send us a P.C. and we will present you entirely FREE—this splendid Brochure entitled:

"MOVING COIL LOUD SPEAKERS"
Simply Explained.

It describes:—Use of Rigid Output Circuits.—Matching the Loud Speaker.—Loud Speaker Impedance.—Multiple Units.—The Output Stage.—The Field System.—Suitable Circuits.—Pentode Circuits.—Coils required for various Valves, etc., etc.

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"Pioneers of the Moving Coil Loud Speaker."
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WEBSON MOVING COIL LOUD SPEAKERS

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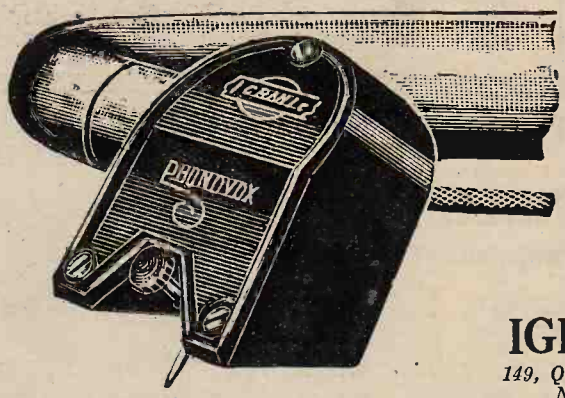
for DANCING IN THE HOME

The PHONOVOX GRAMOPHONE PICK-UP

PRICE - 21/-
Volume Control 7/-
Plug Adaptor 5/-



Make this Christmas a Brighter and more cheery one!

Your records are capable of more than you imagine; why not hear them as they *can be* reproduced by fitting the "Phonovox Pick-up."? It is adaptable to any Gramophone and will transform the cheapest into a first-class instrument by connection to your radio set. Will take either fibre or steel needles. The Phonovox will give you volume, quality and absolute satisfaction.

ASK YOUR DEALER FOR A DEMONSTRATION.

Write for leaflets U319.

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149, Queen Victoria Street, E.C., also MANCHESTER, LEEDS, NEWCASTLE, BRISTOL, GLASGOW, BIRMINGHAM.

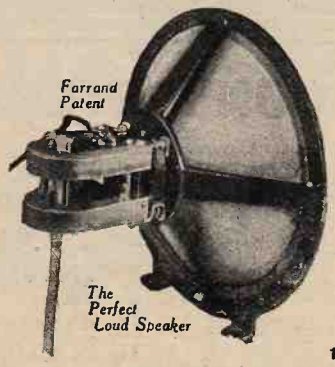
Presents Certain of Good Reception

THE ORIGINAL **N & K INDUCTOR** LOUD SPEAKER

COMPLETE CHASSIS

"The performance is remarkable for the unusual output in the bass.... The general effect is perhaps the closest approximation to that of the moving coil that has yet been achieved with a moving iron armature." — *Wireless World Test Report, July 30th.*

£3.10.0



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Substantially built and excellently finished. Gives perfect reproduction. Width 24". Height 34".
Oak .. £6 10 Walnut .. £7 10
Mahogany £7 0 Oak and Gold £7 0
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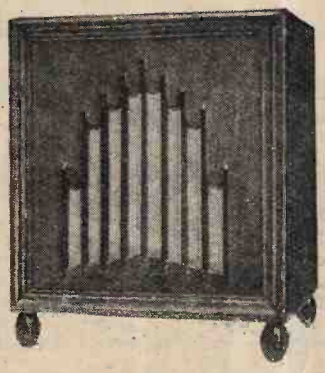
CABINET MODEL

This handsome cabinet is specially designed to avoid box-resonance. The natural beauty of tone of the Speaker is enhanced by the carefully thought-out acoustic properties.

From

£6.6.0



A. BRODERSEN, Sole Distributor,
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THE PERFECT EBONITE

SUPPLIED IN SIX FINISHES

Semi-Polished Black
Highly Polished Black
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Cube Surface

Obtainable from most wireless dealers.

Advertisement of H. B. Potter & Co., Ltd., Station Buildings, ROCHDALE.

A 'JEWEL'

OF A PEN

No. 82.—Fitted with 14 carat gold nib tipped with Super Hard Iridium.

This famous pen will give a lifetime of service.

In all points—fine, medium, broad, etc. Six colours:—Black, Tan, Red Mottled, Green Mottled, Lapis, Jade

Ask for it by name at your stationers or from Sole Makers.

7/6 EVERY PEN GUARANTEED

LEVER SELF-FILLING.

JEWEL PEN CO., LTD. (Dept. 44),
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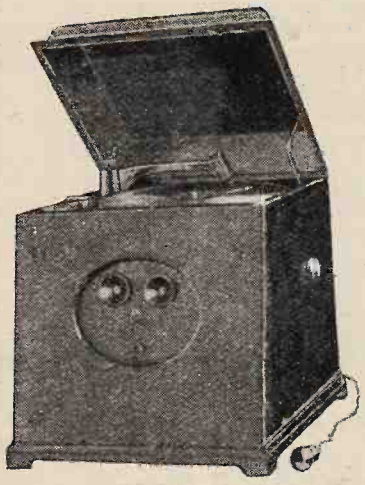
FRANKLY THE PERFORMANCE SURPRISED US!



say the "Wireless Magazine" in their test report of

ELECTROCETS

All electric Table model Radio Gramophone.

Models complete, with spring motor - - - 18 Gns.
" " with Electric motor (AC Mains only) £24

Shall we send you the full test report, together with our illustrated brochure describing our wonderful range of models?

There is a special Electrocet agent in your district who will give you a demonstration, and install the complete instrument for you.

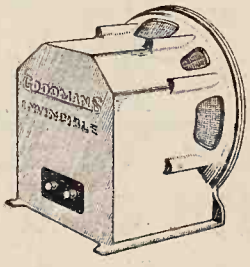
THE ELECTROCET RADIO CO. (Showrooms), Poplar Road, Solihull, BIRMINGHAM.

PERMANENT MAGNET

The

"INVINCIBLE"

Moving Coil Reproducer



Sensitivity, more sensitive than a balanced armature or moving iron type unit.

Quality of Reproduction the highest standard yet achieved.

Fitted with a positive NON-RESONANT centring device.

Exceptionally solid construction throughout, write for full particulars.

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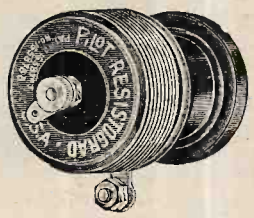

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PILOT RESISTOGRAD

SENSITIVE enough for Volume Control in your Aerial or L.F. Circuit. Range: 20 ohms to 20 megohms.

STURDY enough for Voltage Control in your elimininator. Will handle 20 watts.

Write for Catalogues to:—

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Sole British Agents for all Lines manufactured by the Pilot Radio and Tube Corporation of Lawrence, Mass.

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FORTIFY your Set with a—

Bulwark

TRADE MARK

EBONITE RADIO PANEL

AVAILABLE IN BLACK AND MAHOGANY COLOURS.
Polished one side, also Wavy Surface Design.

AND USE ALSO

REDFERN'S EBONITE LOW LOSS COIL - FORMERS
Supplied in 10 sizes.

Manufactured by—
REDFERN'S RUBBER WORKS Ltd., HYDE, Cheshire.

D.C. to A.C.

ROTARY CONVERTERS

A.C. Receivers will operate from any D.C. source 8-250 volts by using this Converter. The supply given will be entirely free from hum owing to the high efficiency of the smoothing unit incorporated.

60 watt type, as illustrated **£13.3.0**
Rotary only - - - **£10.0.0**

All sizes to 1,000 watts.

Send for lists. *Trade supplied.*

LANG & SQUIRE LTD.,
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CHRISTMAS GIFTS

JUNIT

MAINS UNIT

SERVANT OF THE SET

Junit Mains Unit, the finest unit that can be bought at any price, operates on mains of all voltages from 200 volts to 250 volts.
It is so designed that it can be placed in a vertical or horizontal position to fit into *any* battery recess. You need not buy additional leads—your present leads will easily reach the terminals of a Junit Mains Unit.

Ask your dealer for full particulars.

MASTER OF THE MAINS

Advertisement of the Junit Manufacturing Co., Ltd., 2, Ra enscourt Square, London, W.6

UNIT TYPE 150/4 A.C.
Giving 150 volts at 25 milliamperes load, and incorporating 4 volt centre tapped winding for supplying filament current for indirectly heated valves. Size 9" × 5" × 3½".
Tappings: One variable 0—150
" fixed 150
" " S.G.
Price £5 : 0 : 0

UNIT TYPE 120.
Giving 120 volts at 20 milliamperes load. Size 9" × 5" × 3½".
Tappings: One variable 0—120
" fixed 120
" " S.G.
Price £4 : 7 : 6

UNIT TYPE 120/T.C.
Giving 120 volts output at 20 milliamperes load, and also containing trickle charger for 2, 4 or 6 volt accumulators. Size 9" × 5" × 3½".
Tappings: One variable 0—120
" fixed 120
" " S.G.
Price £5 : 17 : 6

(M.C. 123)

B T-H

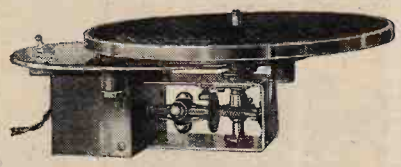
Electric Gramophone Motor

for

Christmas Festivities

Turn your clockwork gramophone into a first-class electrically-operated instrument, by fitting a B.T.H. Electric Gramophone Motor, and hear your favourite melodies and dance music to the best advantage,

Easily fitted—only one hole to cut; will operate from your lighting supply; even speed—never runs down; plays 900 records for one unit of electricity.



No winding
Just switch on!

Costs only £3-3-0
from all high-class dealers.

The British Thomson-Houston Co. Ltd.

ELECTRICAL ENGINEERS AND MANUFACTURERS

Head Office - - - - - - - - Rugby
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Works: Rugby, Birmingham, Willesden, Coventry, Chesterfield.

NATIONAL PORTABLE RADIO

a splendid Xmas Gift

- The National Five-Valve Portable plays at the touch of a switch and brings in Home and Foreign Stations at full loud speaker strength as you turn the single tuning dial.
- Its tone is always pure and true —giving to voices all their natural inflections and keeping music liquid and altogether delightful.
- The National can be carried anywhere, for it is completely self-contained in a handsome oak case with a detachable leather carrying strap.

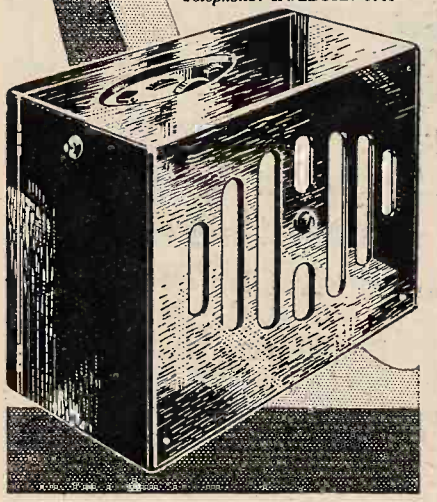
PRICE complete IN OAK **12 GNS.**

De Luxe Model in mahogany **13 GNS.**

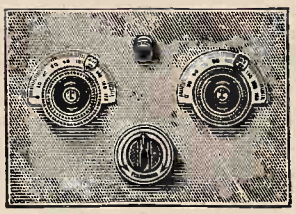
Waterproof covers extra: 3/6 Brown, 4/6 Blue.

Many thousands of National sets have been sold to satisfied purchasers. All good dealers sell and recommend a 'National' Send to-day for free catalogue and full particulars to—

THE BRITISH RADIOPHONE Ltd.
(Dept. W.W.),
Aldwych House, Aldwych, W.C.2
Telephone: HOLBORN 6744



18 to 70 METRES!



Electrocets Empire 2.

SHORTWAVE RECEIVER

(BATTERY OPERATION).

Contained in an oak cabinet, with metal panel. Vernier and direct drive condensers. Vernier reduction 12 to 1. Smooth and free of back lash. Potentiometer control of detector grid voltage. Variable earth, and aerial tappings on a specially wound coil. Changeable coil for wavelengths between 200 and 2,000 metres 8/- extra.

£4 : 5 : 0

3-valve model £5.

Accessories: 2 Osram valves 19/-; 1 pair B.T.H. Sensitive 'phones 15/-; Complete aerial and earth equipment 10/-.

The above models can be made all electric by the addition of our special H.T. and L.T. eliminator (AC mains), £4 : 15 : 0.

The above models can be sent C.O.D. to most countries. Postage and C.O.D. extra.

Agents wanted and Trade enquiries invited. Sample C.O.D.

Illustrated literature Post Free.

THE ELECTROCET RADIO CO.,
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34 Replies!

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"We feel we ought to tell you of the wonderful returns from our small advertisements in 'The Wireless World.' Recently from a small advertisement in your paper we received thirty-four replies. From another publication we received seven replies."

The All Mains Radio Company,
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Forest Hill,
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FAMOUS FOR ECONOMY

NOW ONLY 17/6

Judge your batteries on performance—not on price. Columbia 4780 (60 volts, Triple Capacity) now reduced to 17/6, is the most economical battery you can buy. Throughout its long life it gives you smooth-flowing power; pure trouble-free radio; better all-round performance. Remember the name — Columbia 4780 costing 17/6.

For large Sets employing power valves, Columbia "Layerbuilt"—truly a battery and a half. No. 4486, 45 Volts 24/-
For 2- or 3-Valve Sets, Columbia No. 4721 10/6
For Portables Columbia 4755, 99 Volts .. 18/-
Columbia Grid Bias Battery 9 Volts No. 4756 2/-

Columbia RADIO BATTERIES

J. R. MORRIS, Imperial House, 15, Kingsway, London, W.C.2.
Scotland: J. T. Cartwright, 3, Cadogan St., Glasgow.

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"DUTY."

You have done the right thing. You are glowing all over with righteous satisfaction, for "duty has been done."

Yes, you have toiled and moiled through miles and miles of "Stores." You have made a purchase for Mother, Father, Sisters, Brother, the Baby and the Best Girl. Your pocket may have been deep enough to include the Family, even unto Third Cousins. Your bounty may even have extended to Mere Friends.

BUT WHAT ABOUT YOURSELF? COUNT YOUR FEW REMAINING SHEKELS AND SPEND THEM WISELY WITH CLAUDE LYONS LIMITED. SEND FOR OUR CATALOGUES AND SEE HOW YOU CAN EXTRACT THAT LAST OUNCE OF PLEASURE FROM YOUR RADIO. YOU HAVE EARNED IT!

SWITCHES. "GADGETS." VOLUME CONTROLS. QUALITY PARTS. DIEHL A.C.-INDUCTION MOTORS. AUDAK 16" TALKIE PICK-UPS. RECEIVERS. A.C. and D.C.-OPERATED AMPLIFIERS. ROTARY CONVERTERS, etc., etc. IN FACT, PRESENTS FOR YOURSELF FROM 2/- UP TO ALMOST "NO LIMIT."

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25. WARREN STREET, NEW YORK, U.S.A.

A Really Magnificent Christmas Gift

The CAMCO CABINETWORKS

BERKELEY
Radio-Gram Cabinet

YOU, too, should build your Set in this Cabinet which is modern in design and beautifully finished in **Walnut, Mahogany** or **Oak** Veneers. For 18" × 7" Panel; 16" Baseboard; Speaker Compartment 18½" × 17" × 16" deep, with Baffle Board. Height 45".

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(Factory: S. Croydon)

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AN ALL-ELECTRIC RADIO-GRAMOPHONE AT £37:10

THE IDEAL PRESENT FOR XMAS

This amazing low figure creates a price revolution in this form of luxurious home entertainment. An all-electric radio-gramophone with the full reputation of "BEL-CANTO Radio" behind it, is now within the reach of all, and the price makes it a particularly suitable present to give this Xmas. It is easy to work and consumes less current than an ordinary house lamp.

Get a BEL-CANTO and ensure successful Xmas entertainment—the best of the broadcast and the best of the records at a touch.

The latest and most complete development of the radio industry is the BEL-CANTO Radio-Gramophone at £37.10.0 or £9.7.6 and 11 monthly payments of £2.16.3.

Other models at £48 and £75.

Also Loud Speakers and Units. Write for illustrated catalogue and terms.

BEL-CANTO
REALISM in RADIO
Estd. 1926

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Please send me illustrated catalogue and details of hire purchase.

Name.....
Address.....

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"Jolly's Again"

Special Bargains in

"LEWCOS COILS"

that can be obtained from

Jolly's of Witton

ALL BRAND NEW BOXED GOODS.

List No.	Description.	Quantity.	List Price.	Our Price.
1	Aluminium Pot Screens and Bases with Terminals	490	6/-	2/6
SST 4	Split Secondary Transformers ..	19	8/6	2/-
SST 5	,, ,, ,, ..	90	8/6	2/-
SST 8	,, ,, ,, ..	32	8/6	2/-
SST 15	,, ,, ,, ..	24	8/6	2/-
SST 20	,, ,, ,, ..	152	8/6	2/-
SSTP 4	Split Secondary Tapped Primary Transformer	50	8/6	2/-
SSTP 15	Ditto	24	8/6	2/6
SPA 6	Split Primary Aerial Coil ..	35	8/6	2/6
SPT 8	,, ,, Transformer ..	84	8/6	2/-
SPT 12	,, ,, ,, ..	16	8/6	2/-
MRT 5	Magnetic Reaction Transformer	66	8/6	2/-
MRT 20	,, ,, ,,	76	8/6	2/-
RTA 5	Reinartz Aerial Coil	74	8/6	2/-
RTA 20	,, ,, ,, ...	62	8/6	2/-
RT 5	,, ,, Transformer ..	209	8/6	2/-
RT 8	,, ,, ,, ..	49	8/6	2/-
RT 20	,, ,, ,, ..	177	8/6	2/-
TL 5	Inductance Coil	40	8/6	2/-
TI 20	,, ,, ...	32	8/6	2/-
BAR 5	Binocular Anode Coil	147	8/6	2/-
BAR 20	,, ,, ,, ...	391	8/6	2/-
BTA 5	,, ,, ,, ...	116	8/6	2/-
BTA 20	,, ,, ,, ...	98	8/6	2/-
BSS 4	,, Split Secondary Coil	102	8/6	2/-
BSS 15	Ditto	172	10/6	3/-
BRT 5	Binocular Reinartz Transformer	81	8/6	2/-
BRT 20	,, ,, ,,	108	10/6	3/-
BTP 4	,, Tapped Primary Trans.	53	8/6	2/-
BTP 15	Ditto	64	10/6	2/6
75X	Old Type. Double Tapped ..	13	4/9	1/6
200X	,, ,, ..	143	6/6	2/-
300X	,, ,, ..	25	6/6	2/-
LAT 20	Old Solodyne	1,159	12/-	3/6
LAA 20	,, ,, ...	434	12/-	3/6
LAT 5	,, ,, ...	1,560	10/6	2/6
LAA 5	,, ,, ...	583	10/6	2/6
L.B.	Bases for Above	1,865	2/-	1/-
QAA	Q. Aerial Coil	14	15/-	3/9
QAR	,, ,, ,, ...	13	15/-	3/9
QARA	,, ,, ,, ...	16	15/-	3/9
QSG	Q. Screened Grid Coil	14	15/-	3/9
QAS	Mullard Master Coil	86	15/-	3/9
QAM	,, ,, ,, ...	30	15/-	3/9
RAS 4	Ultra Short Wave	12	6/-	2/-
RAS 9	,, ,, ,, ...	70	6/-	2/-
WT 5	Old Type Wave Trap	22	11/6	2/6
WT 15	,, ,, ,, ...	44	11/6	2/6
WT 20	,, ,, ,, ...	93	11/6	2/6
TAC 5	Touchstone Coil	154	15/-	3/-
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Terms: Cash with Order.

All Orders overs 5/- Carriage Paid.

Special Prices for Quantities.

All Goods can be inspected at our Showroom!

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410-416, Aston Lane, Witton, Birmingham.

Also Aston Road, Birmingham.

Phone: East 687.

there is *no* Xmas gift problem—give a *good* pair of Telephones

There's your short wave friends—burners of the midnight oil ..... and Auntie who remains faithful to her old love—the crystal set you made her in '25.

Give them all Ericsson Super Sensitive Telephones—*good* receivers every pair—chosen by the Post Office, the B.B.C. and many long distance overseas stations. Comfortable, wearable and light.

120, 2,000 and 4,000 ohms.

12/6

All *good* dealers stock them or direct from:

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67/73, Kingsway, London, W.C.2

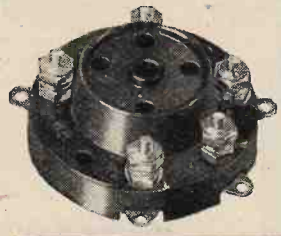
Ericsson

BRITISH SUPERSENSITIVE TELEPHONES.

W.B. VALVE HOLDERS

WELL-KNOWN BRITISH SET MANUFACTURERS USE THEM

Price 1/- with Terminals



FOR these reasons well-known British Set Manufacturers insist on W.B. Universal Valveholders for their sets; they are compactly designed to take either 4- or 5-pin valves. They have special spring contacts which grip firmly the pins of the valve. They are very highly insulated, making leakage impossible They have screw terminals, making soldering unnecessary. Follow the lead of well-known British Set Manufacturers—use W.B. Valveholders in your own set. *Made by the makers of the famous W.B. Cone Speakers and Switches.*

W.B

Whiteley Electrical Radio Co. Ltd., Radio Works, Nottingham Rd., Mansfield, Notts.

EXPERIMENTAL WIRELESS & The WIRELESS ENGINEER

W.W.2

The Journal for Professional Engineers and Advanced Wireless Experimenters

Monthly **2/6 net.** Annual Subscription **32/- post free.**

ILIFFE & SONS LTD., Dorset House, Tudor Street, London, E.C.4.

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The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors. — Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

HIGH Quality Solodyne, with 2 H.F. S.G. Osram, 1 P.M.5X 6-volt valves, wired complete, less output stage, best components, perfect condition, illuminated drum dial, enormous range; what offers?—1, Balmoral Terrace, Gateshead. [2410

B&J

"WIRELESS WORLD" FOUR.

Coil Screens - - 3/- each.
Valve Screens - - 2/9 each.
(with special ventilation holes and insulated top.)

Approved by "The Wireless World."

Send particulars of your requirements for

MAINS, TRANSFORMERS & CHOKES

B & J. Wireless Co.

ATHELSTANE MEWS, N.4.

Arc. 1695

WITHOUT FEAR—

Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.

Particulars from the Secretary.

HONOR OMNIA SUPER

APPLEBY'S,

Chapel St., Marylebone, London

"APTUS" LINEN DIAPHRAGM
TRIPLE CHUCK ADAPTER
FOR DOUBLE LINEN SPEAKERS
BUTTON-HOLING NOT REQUIRED
FITS ALL UNITS

COMBINED BRASS AND CELLULOID WASHERS. PREVENTS RATTLE.

EXPERTS SAY:—"The most Successful Centre yet Devised."

PRICE 2/6 POST 3d.

SPECIAL CENTRE FITTING FOR SINGLE DIAPHRAGM WITH WIRE, ETC. 2/9
"APTUS" CELLULOID DOPE 1 oz. 2/9
" " " 5 oz. 1/6
DOPE BRUSH .. .. .. 6d.
SPECIAL IRISH LINEN, per sq. yd. 6/6
8 ANGLE BRACKETS with Screws 1/6
RUBBER .. .. .. 6d. yd.
SET (4) 2 B.A. RODS (16 NUTS and WASHERS) 1/6
Latest type UNITS. Post free.
MOTOR, 27/6. BLUE SPOT 66K, 25/-. 66P, 27/6. 66R, 35/-. HEGRA, 19/-. CHIMES, 16/6. SUPER BULLPHONE, 12/6. ANY MAKE from stock.

"A.W." SINGLE DIAPHRAGM LINEN SPEAKER KITS. LISTS FREE.

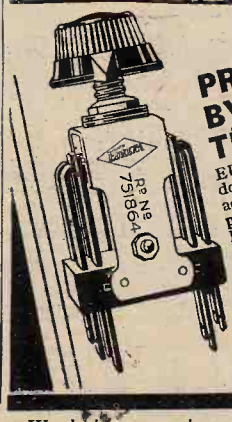
Makers of "APTUS" Specialities.

MOORE & CO.

(Nearly 50 Years Character for Honest Trading.)

101 & 103, Dale Street, LIVERPOOL.

'Phone: Cen. 5284. 'Grams: "Solutions."



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EUREKA multi-pole double-throw anti-capacity switches of improved design, with Nickel-silver contacts.

Write for descriptive folder No. 145.

PRICES: 2-pole, 3/-; 3-pole, 3/9; 4-pole, 4/6.

Pull Push Switches, 1/3.

L.F. Transformers & Chokes.

L. PERSON & SON, Dept. 4, 63, Shaftesbury Street, London, N.1.

Clerkenwell 7139.

IMPORTANT NOTICE.

Owing to the Christmas Holidays, the next two issues of "THE WIRELESS WORLD" are closing for press earlier than usual.

In accordance with the Notice that appeared last week, the latest date upon which Miscellaneous Advertisements could be accepted for the issue of December 17th was WEDNESDAY, December 10th.

For the issue of December 24th advertisements for these columns can be accepted up to FIRST POST, WEDNESDAY, December 17th.

Receivers for Sale.—Contd.

END of Year Clearing.—The following slightly used material is offered subject to sale; every item will be severely tested before despatch and guaranteed in workable condition; prices quoted for receivers include set of tested valves to suit; in the case of portable receivers batteries are included.

McMICHAEL Screened Dimic Three, 3 only at 10 guineas each; Bowyer-Lowe 2-valve S.W. receiver, with coils, 10 to 2,000 metres, det. and pentode, 150/-; G.E.C. 3-valve S.W. receiver, with coils, 10 to 600 metres, det. and 2 L.F., 125/-; G.E.C. World Wide Four, 2 S.G., det., power, with 2 frame aerials, 250-2,000 metres, 340/-; another, ditto, ditto, 250/-; another, ditto, ditto, 180/-; G.E.C. Screened Three, 163/-; another, ditto, 155/-; G.E.C. 8-valve superhet., frame aerial 250-2,000 metres, 250/-; another, ditto, ditto, 215/-; Truphonic 5-valve portable Melo-Set, 170/-; Selector 4-valve S.G. portable De Luxe, 290/-; Haleyon 4-valve S.G. portable De Luxe, 295/-; another, ditto, ditto, 265/-; Baird television kit, complete, 207/6; M.L. motor generator outfit, input 240 volts D.C., output 400 volts 100 m.a. and 6 volts 5 amps., complete with output smoothing equipment and cut-out, 345/-; another, ditto, ditto, 290/-.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0340

MARCONIPHONE Model 35 3-valve (S.G. and Pentode) Set; cost £12, accept £6.—Box 8299, c/o *The Wireless World.* [2390

CLIMAX All-mains Electric Receiver, 200-250 A.C., new condition; £6/10.—Barrington, 186, St. James's Rd., Croydon. [2414

LOOK!!!—New 2-valve A.C. and D.C. receivers, complete; £4!!! C.o.d.; wonderful performance. —96, Brockley Rise, S.E.23. [2426

OSRAM Music Magnet 3, as new, with valves, wired; £6/10, or offer.—G. Bayley, 7, Valentine Rd., E.9 [2427

1930 New Kilo Mag Four, with separately tuned aerial circuit, Ritherdon cabinet, complete with valves, everything brand new; £12.—Hopps, Thurlaston, near Rugby. [2424

SILVER Marshall, 6-valve, complete with valves, dual range, mahogany finished cabinet; bargain, £15; first cheque secures; no offers.—Hewitt, Springfields, Bedworth. [2416

BEL Canto 4-valve S.G. Set and Speaker, accept low offer; also a P.M.3A and a P.M.4 valve, both unused, at half price; view after 7 p.m.—Best, "Carruthers," Northumberland Rd., New Barnet. [2398

MODEL 82 Marconi, 8 valves, super het., complete with frame aerial and valves, in perfect condition; a sacrifice, cost £55, will accept £17/10.—Mills, 63, Grainger St. West, Newcastle. [2388

SIMMONDS BROS. are Specialising on "Wireless World" Four and Other Modern Receivers; superb workmanship guaranteed; exchanges.—38, Rabone Lane, Smethwick. [2155

YOUR Old Receiver or Component Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

1930 Everyman Four to Specification, Ritherdon cabinet, valves, Mazda S.G.215, remainder 6-volt, complete with Blue Spot linen speaker, £14; also Ferranti B.E.M.1 eliminator, £12; all new this year.—Box 8364, c/o *The Wireless World.* [2486

"R & B"

MAINS TRANSFORMERS

Designed for "Wireless World" Circuits

MODEL "35"
Specified in Oct. 15th issue
"WIRELESS WORLD FOUR"
Price **£2 . 5 . 0**

MODEL "34"
Specified in June 25th issue
"BAND PASS FOUR"
Price **£2 . 5 . 0**

MODEL "27"
Specified in Aug. 13th issue
"REGIONAL ONE"
Price **£1 . 10 . 0**

Please state voltage and frequency of supply mains.

Manufactured by
RICH & BUNDY, LTD.,
13, New Road, Ponders End, Middlesex.
'Phone: Enfield 0777.

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E. G. WOOD, 2, Queen Street, E.C.4.
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Beautifully finished in highly polished OAK.
Will take sets
18" × 7" × 16" or 21" × 7" × 16"
Spacious compartment for speaker and batteries. Overall size 36" × 24" × 19".
9-ply motor board.

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Carriage forward.
Fitted complete with D.S. Motor, B.T.H. Pick-up and Arm, Ormond Unit and Chassis **£7.15.0**
This is all you need to turn your present set into a modern RADIO-GRAMOPHONE.

PREMIER SUPPLY STORES
Radio & Gramophone Specialists,
165, Fleet St., London, E.C.4
'Phone: Central 2833
Large selection of Gramo-Motors and pick-ups always in stock.

The Autocar EVERY FRIDAY, FOURPENCE

Receivers for Sale.—Contd.

MARCONIPHONE, models 61 (3 S.G.) £12, model 44 (2 S.G.) £10, model 304 short wave £10; all complete with valves.—Box 8366, c/o *The Wireless World.* [2488

PETO-SCOTT Mahogany 5-valve Solodyne, overhauled last week by makers, guaranteed perfect, no valves, cost £35, sell £8/8; also brand new Celestion mahogany Z20, cost £8/5, sell £6.—Sage, Fishmonger, Barnet. [2482

PHILIPS Three, A.C.100-105, type 2514, complete with Philips £5/5 speaker, type 2007; £17.—'Phone: Abercorn 1328 between 7-8 p.m. [2474

EVERYMAN Four, complete (5 valves), Marconi cone speaker, 120v. H.T.; lot £7/10.—Marks, 'Phone Paddington 9712 between 7-8 p.m. [2473

"WIRELESS World" Kilo-Mag Four, complete with valves; what offers? Owner leaving country.—J. Bright, 54, Leinster Sq., W.2. [2466

McMICHAEL Super Range Portable, cost £23/2, also ball bearing turntable, guaranteed as new, latest type; bargain, £16, or near offer.—Lepard, 62, Wightman Road, N.4. Mountview 4247. [2463

MARCONIPHONE Model 61, adapted for H.T. eliminator, £25; M.C. speaker to match, £5; all O.K.—Apply Hart, 19, Village Rd., Enfield, Middlesex. [2461

5-VALVE All-electric A.C. S.G., any voltage; death reason sale; complete; £8.—43, Catesby St., London. [2460

18-GUINEA Marconi Portable, with batteries and valves, £10; 11-guinea Lissen mains portable, 200-250 A.C., £7/10; Music Magnet Three, assembled with valve, £5/10; all guaranteed perfect.—Harris, 62, Greenfield St., Commercial Rd., E.1. 'Phone: Bishopsgate 4593. [2457

STRAIGHT Eight Marconiphone, 6 new valves, long range coils; £10.—M., 21, Coningham Rd., Shepherd's Bush, W.12. [2456

KOLSTER-BRANDES No. 169 All-mains A.C. 200-250 3-valve Set, as new, for sale, listed at £19/19, Celestion C10 speaker, listed at £6/10; first offer of £15 for both accepted; any demonstration given.—M.M., 44, Chandos Rd., N.W.2. [2452

TRIX Portable, 4-valve, perfect, complete; £3/15.—2, Dollis Hill Av., Cricklewood. [2446

ALL-MAINS Receivers, 2-valve, £5/10; 3-valve screened grid, £12/10.—Brooks, 3, Anselm Rd., Fulham. [2443

PHILIPS 3-valve 210v. A.C. Receiver, perfect, 16 guineas; speaker type 2007, 75/-; Mullard C speaker, 35/-; Columbia portable, £14.—185, Filton Av., Bristol. [2442

FOR Sale, all-mains radiogramophone, for any voltage mains, A.C. or D.C.; price £25.—Holland, Spital Park, Brombough, Ches. [2438

READY for Immediate Delivery, your old set taken in part payment.—McMichael super range portable, latest type, in leather suitcase; Osram music magnet, latest type, two-screened grid, tested ready for use; Ultra, all mains, direct current, 200-250 volts, latest type, screened grid; McMichael, all mains, latest type, alternating current, 200-250 volts; Ultra, all mains, alternating current, latest type, 1931 model, any trial; all types of sets in stock, it will pay you to call, send a postcard, or telephone for your requirements.—'Phone No.: Sloane 9077. Address, H. Passmore, 8, Grosvenor Gardens Mews (North), Victoria, London, S.W.1. [2436

BRITISH Brunswick Panatrope Electric Gramophone, B.T.H. Senior model, walnut cabinet, 200-250v. D.C., motor and generator and wireless attachment, perfect; genuine bargain, cost £200, only £50.—Harger, 3, Darnley Rd., Hackney, E.9. Amherst 1842. [2434

DUBILIER 3-valve A.C. All Mains Receiver; £18/18, cost £25 this year; would entertain part exchange battery set.—Alpha, 42, Olive Rd., Cricklewood. [2431

"WIRELESS World" Kilo Mag Four, with push-pull output, complete with valves, £14; Foreign Listener's Four, £19; professionally built, demonstration.—Pearson, 27, Woodberry Grove, Finchley. [2479

ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators, by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0623 (3 lines). [1466

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and METHODS of TUNING.

(1925)

By W. JAMES.

A VERY useful manual giving the maximum of information on the subject. Following a simple explanation of the principles of wireless, the author discusses the many methods of tuning circuits, with explanations of spade, condenser and variometer tuning. Other chapters treat in detail of the choice, construction and design of coils, and give particulars as to size of coil required, the best shape, size of wire, type of insulation, and special uses of the various coils.

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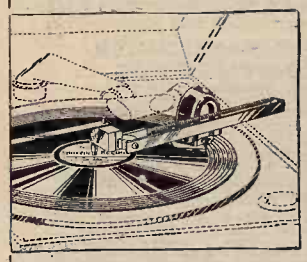

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All brass parts are chemically treated.
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DIFFERENTIAL CONDENSER

Write for illustrated Catalogue to
GARNETT, WHITELEY & CO., LTD., LIVERPOOL.

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EIGHT Exide WY10 Units, hardly used; £2.—Chalmers, 169, Villiers Rd., Kingston. [2477

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PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value: for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5, 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5, 150v., at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

H.T. Eliminator Kit, incorporating Westinghouse H.T.5 rectifier, kits consist of transformer, choke, Westinghouse rectifier; required condensers, resistance, safety plugs and sockets, and baseboard; output 20 milliamps at 120 volts, 47/6, post free; metal case for same, 3/9 extra.

ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

VORTEXION Transformers and Chokes, wound to specification; best quality components only supplied.

VORTEXION No. 4 Bobbins, 1in.×1½in., 1/3, post 2d.; 1in.×1in., 1/-, post 2d.; cast aluminium end plates, 2/3 per pair, post 2d.; No. 4 laminations for 1½in. bobbins, 6/2, post 9d.; for 1in. bobbins, 4/2, post 6d.

VORTEXION, 72, Merton Rd., Wimbledon, S.W.19. Tel.: Wimbledon 2814. [0439

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

PHILIPS High Tension Union, 100 volts A.C., type 372, 3 tappings, 1 variable, purchased March last, cost £6/10, guaranteed absolute new condition and perfect working order; £2/17/6.—Below.

PHILIPS Trickle Charger, type 1016-1017, 100 volts A.C., purchased March last, cost £2/15, guaranteed absolute new condition; £1/1.—Allen, Crabbes Cottage, Aldeburgh, Suffolk. [2386

PHILIPS H.T. Eliminator, 220 A.C., perfect condition, with spare valve: £3.—Turner, 17, Augustus Rd., Wimbledon Park, S.W.19. [2421

EXIDE H.T and L.T. 200-250-volt Charger, in perfect condition; cost £8/10, accept £4.—Box 8300, c/o *The Wireless World*. [2391

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

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SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

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SAVAGE'S New Foreign Listeners' Four Equipment.—Transformer, N.F.I.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/0, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains transformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

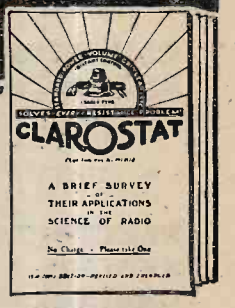
SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone: Bishopsgate 4297. [1784

The 1930 CLAROSTAT BOOK



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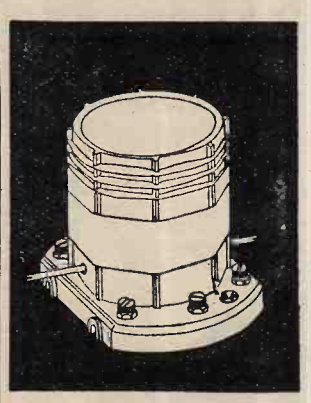

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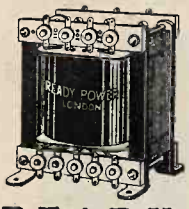

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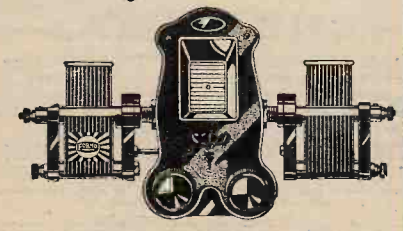

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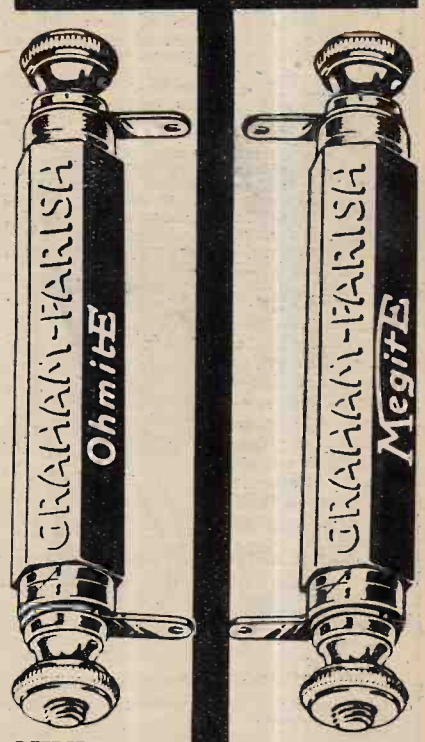

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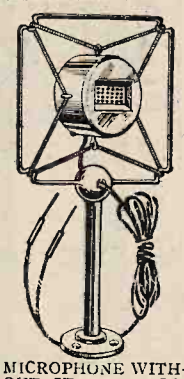

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NEARLY New A.C. P.1, 8/6; P.625a, 6/6; A.C. H.L., 7/-; Collaro motor, 11/-; perfect.—48, Warren, Heston, Middlesex. [2431

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COILS.—James' Brookman's Three, 21/-; ether searcher, 11/6; Clarion Three. 13/-; Marconi Ideal transformer, 6-1, 18/-.—Vicor, Twyning, Tewkesbury. [2464

P.M.24. 10/-; Centralab 500,000, 4/6; P.M.4D.X., 5/-; Mullard Permacore, 10/-; P.M.14, 10/-; Ferranti O.P.M.2, 13/6.—"Cintra," Ramsgate Rd., Broadstairs. [2458

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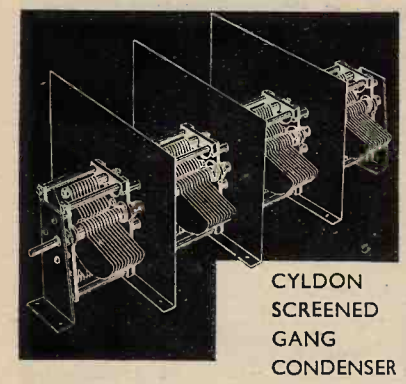

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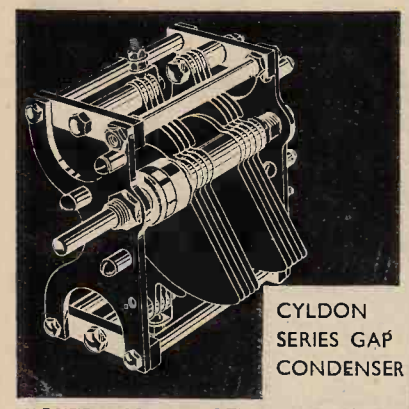

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B.T.H. Gramophone Motor, 45/-; Lotus H.T. and L.T. relay, 10/-; 2 Westinghouse G.B. rectifiers, all as new, 10/-; R.I. S.L. transformer, 10/-.—Electrocet Radio Co., Solihull, Birmingham. [2397

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LAMPLUGH Silver Ghost Speaker, 50/-, in mahogany cabinet, 30/-; suitable Ferranti output transformer, 16/-.—Legge, Countisbury, Park Rd. West, Wolverhampton. [2420

ALMOST New Valves, P.M.252, 7/-; P.M.1 H.F., 4/-; screen grid choke, 2/6.—Baybut, 30, Hainault Rd., Chadwell Heath, Essex. [2419

FERRANTI O.P.4C, 15/-; two P625A's, 14/-; 8-stud switch, 2/6.—Pepler, 257, Bramford Rd., Ipswich. [2418

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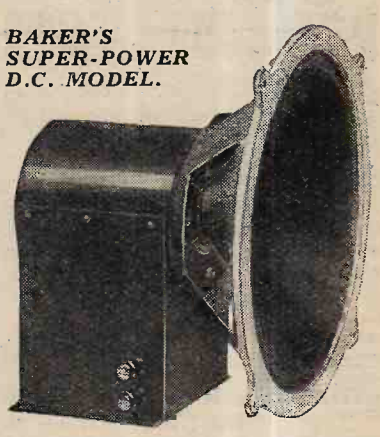

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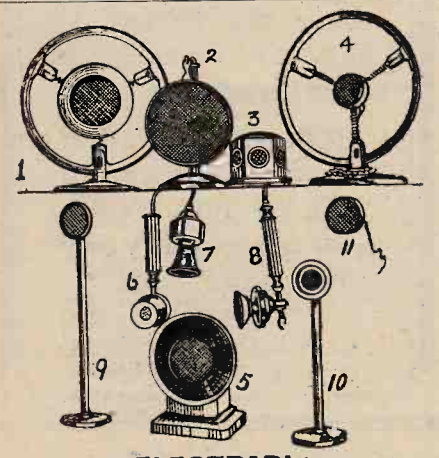

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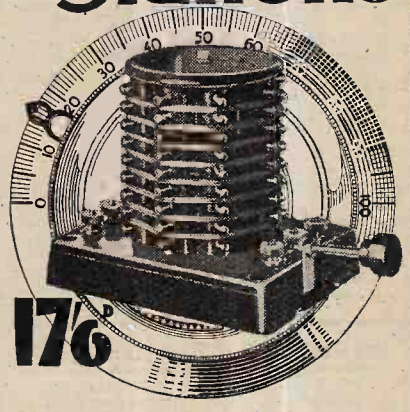
Separate those Stations



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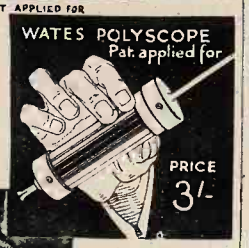

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W.W.84

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W.W.90

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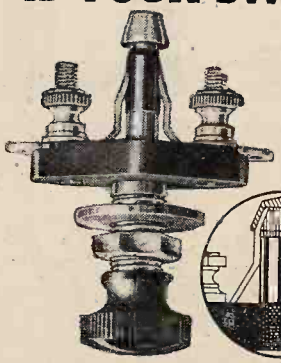

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12/6 With Hand Rest.

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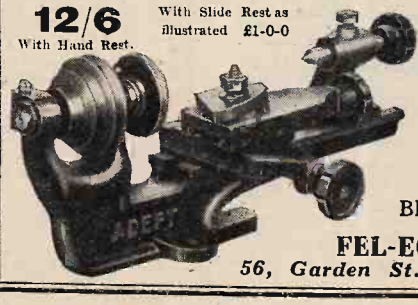

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Give yourself or your friend one for Christmas.

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2-VALVE BATTERY SET An efficient loud speaker set for Christmas, complete with valves and leads. Remarkable reproduction. Order from your local dealer or the manufacturers,

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FOR CONTACT

Is your Set O.K. for Christmas?

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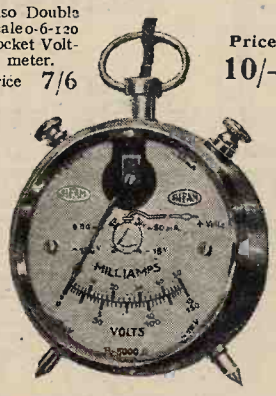

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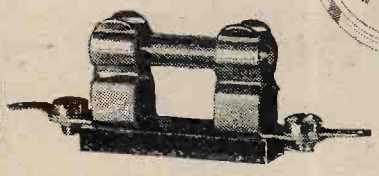

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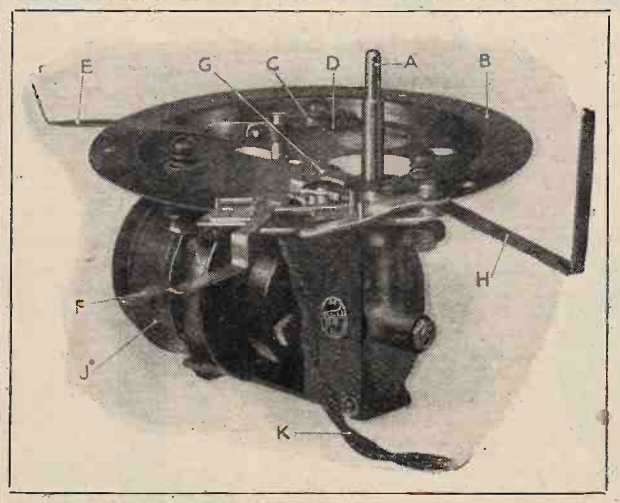

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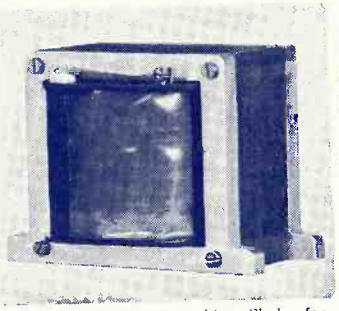

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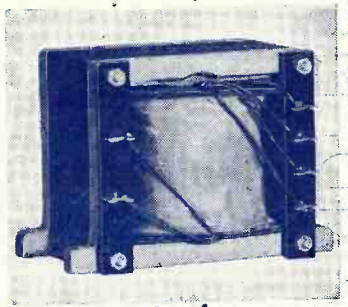

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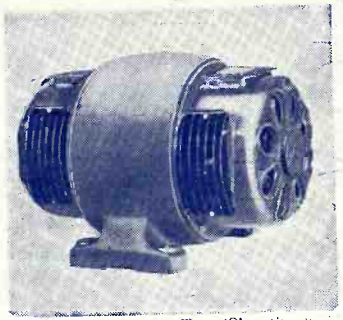

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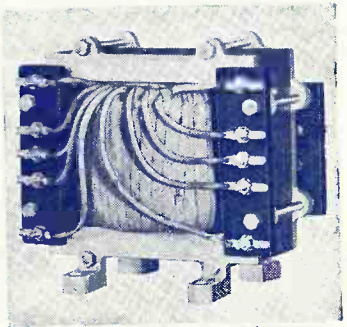
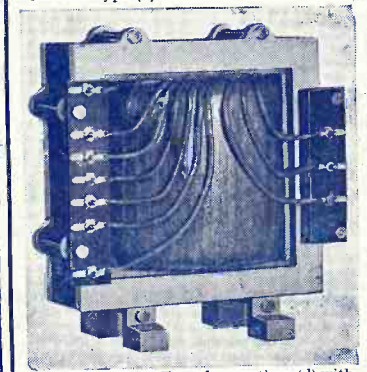


(d) Small power Transformer where somewhat larger outputs are required than our smallest type (b). Prices from **35/-** each.



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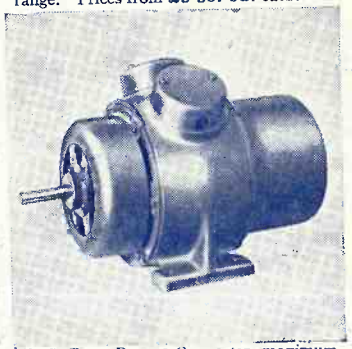

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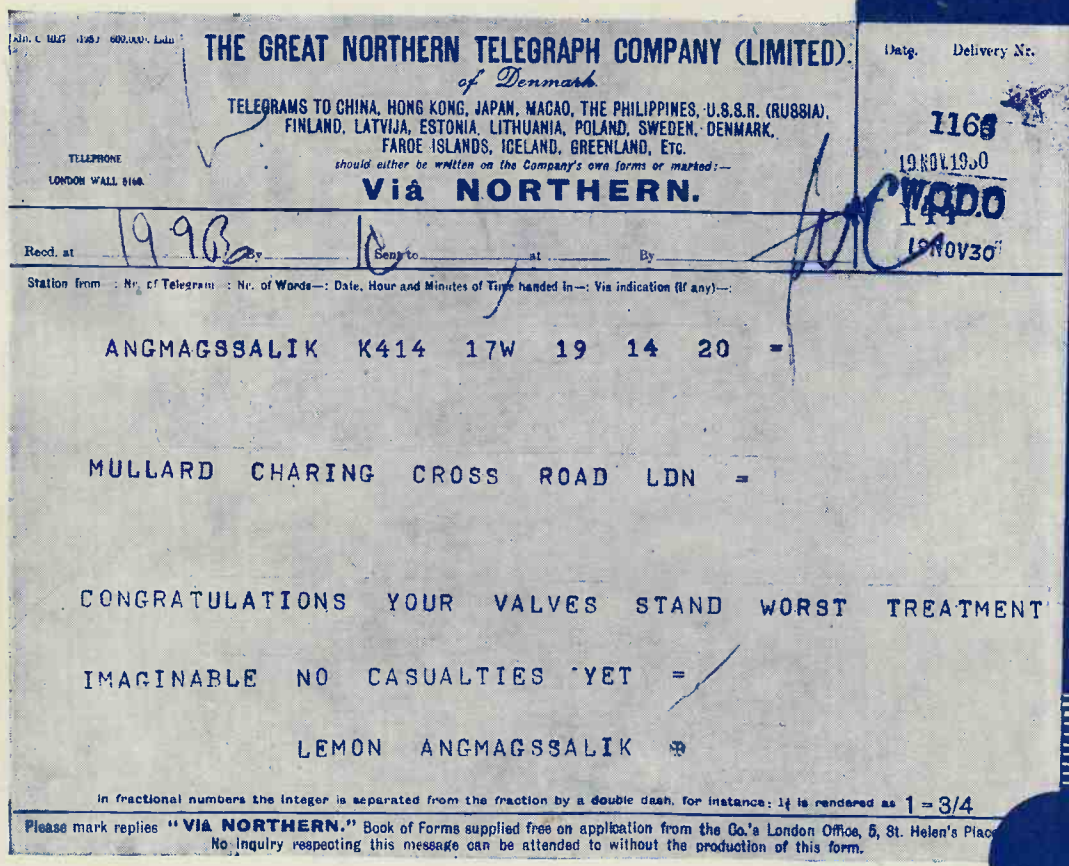

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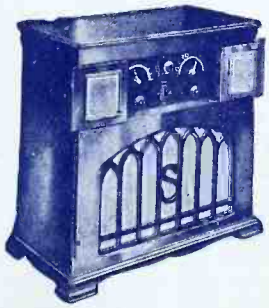

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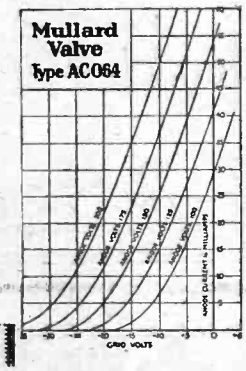
A.C. 104 A.C. 064 A.C. 044



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	A.C. 104	A.C. 064	A.C. 044
Fil. volt.	4.0v.	4.0v.	4.0v.
Fil. cur.	1.0 amp	1.0 amp	0.7 amp
Max. An. volt.	200v.	200v.	200v.
‡An. ampd.	2,850	2,000	1,150 ohms.
‡Amp. Factor	10	6	4
‡Mut. cond.	3.5	3	3.5 mA/volt.
PRICE	16/-	16/-	22/6

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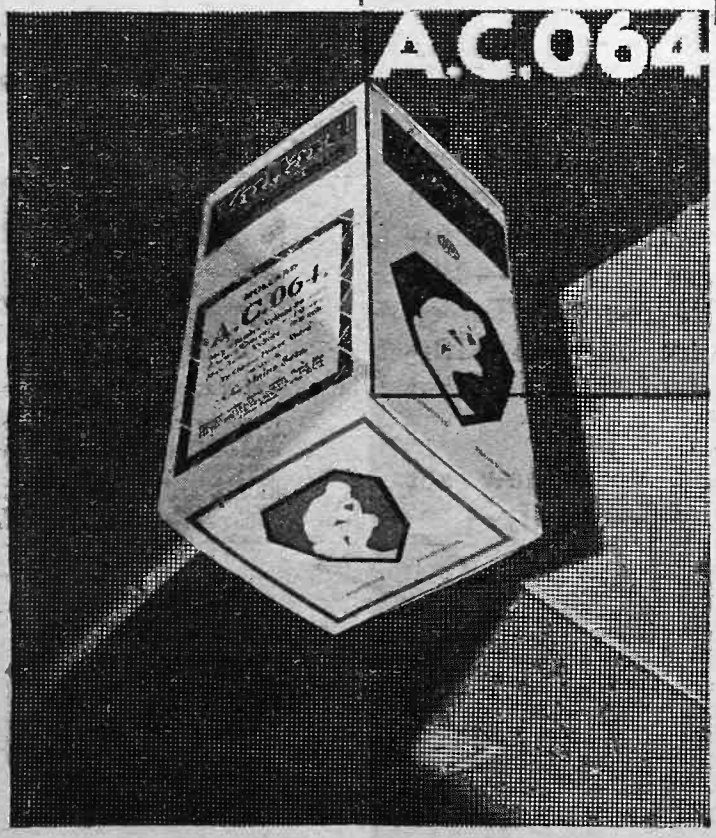

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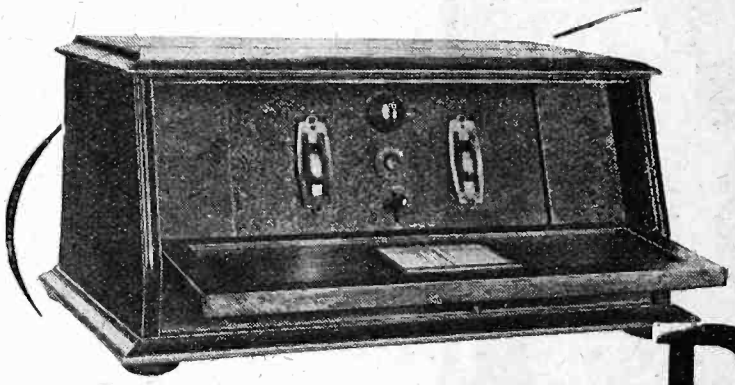

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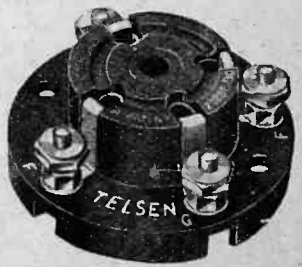

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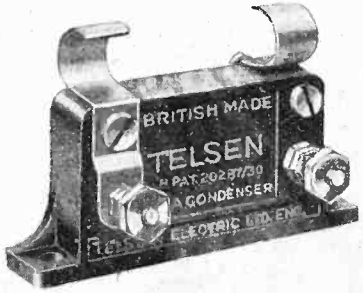

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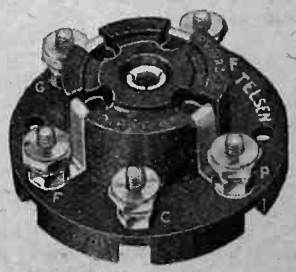

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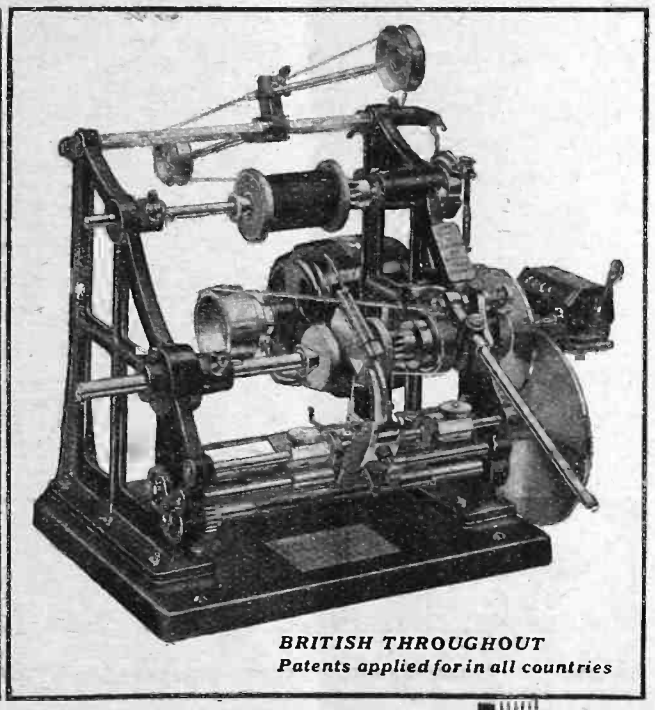

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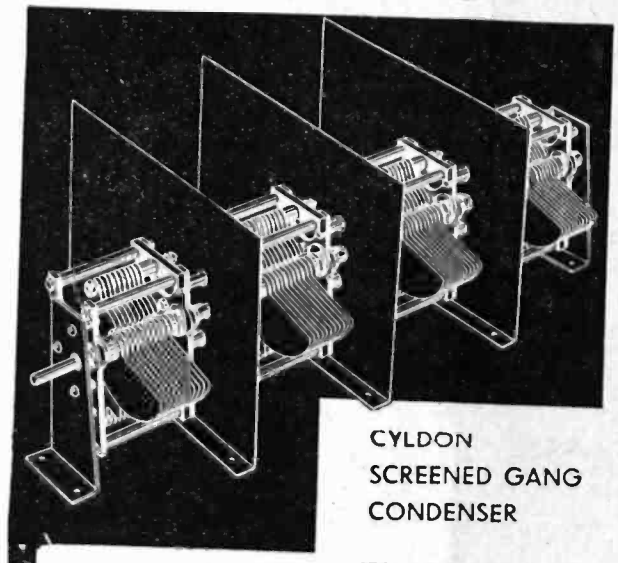

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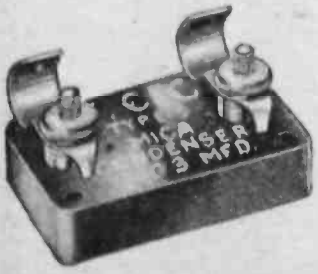

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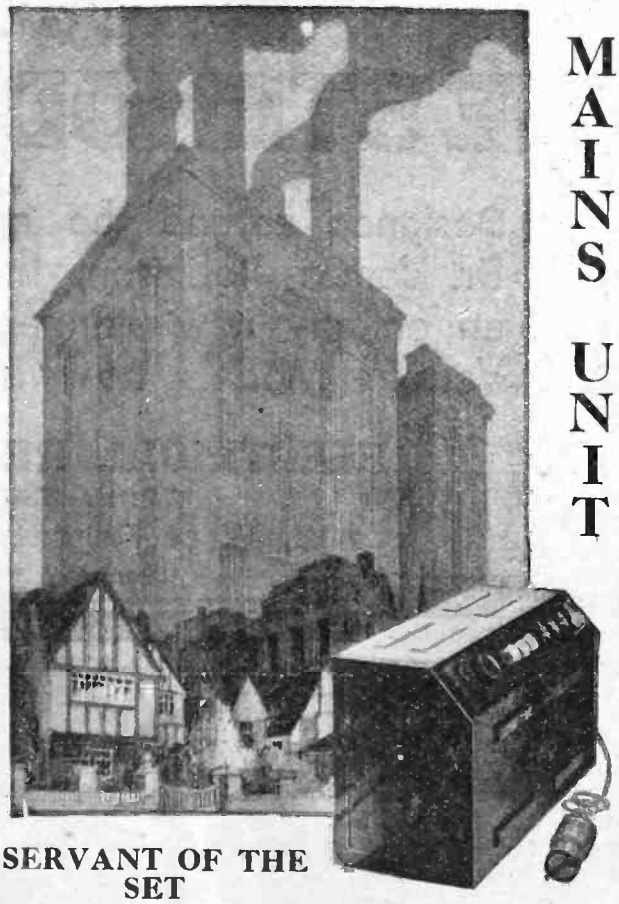
MAINS UNIT



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Resistance secondary D.C. 8,000 ohms.
Ratio 4 to 1.

Since its introduction many thousands have been used by manufacturers in their standard sets, and thousands more have been employed by home constructors — it has won world-wide recognition as the best. Its amazingly high primary inductance, amplification and uniform frequency response, coupled with its exceedingly small weight and size, makes it the ideal intervalve transformer for modern, compact circuits.

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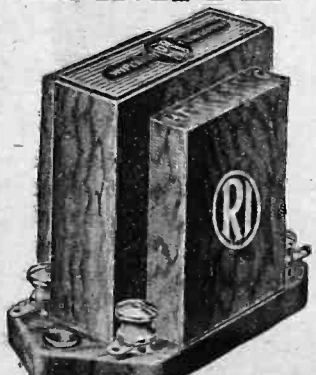
With primary inductance of 50 henries, although only weighing 7 ozs., "Hypermite" is the smallest commercial intervalve transformer ever produced with this electrical characteristic. Where considerations of weight and size are of paramount importance this transformer meets the needs of radio designers and constructors, and has been adopted by many noted manufacturers of portable receivers because of its amazing volume and quality of reproduction. Its remarkable performance is only made possible by employment of the Nikalloy core.



Inductance primary 50 henries.
Resistance primary D.C. 1,000 ohms.
Resistance Secondary D.C. 6,000 ohms.
Ratio 3½ to 1.

12/6

Ask your dealer for leaflets fully describing these components, also for complete Catalogue. If any difficulty write direct, giving name of usual dealer.

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The New Marconi LP2 Masterpiece!

A HIGH AMPLIFICATION POWER VALVE—

AMPLIFICATION FACTOR 15!

STUDY THESE CONVINCING FACTS

1. A power valve with an amplification factor of 15—a hitherto unheard of figure.
2. Mutual conductance 3.85 milli-amps per volt—the highest valve efficiency yet achieved irrespective of type.
3. Stage gain thus comparable under working conditions to that given by a pentode.
4. Impedance only 3,900 ohms—a figure perfectly matching the average speaker.
5. Provides reproduction of exceptional quality without the sacrifice of volume from distant stations.
6. It is the supreme output valve for portable and most battery operated sets.
7. Strictly economical in current consumption—H.T. current only 5–6 milli-amps under normal conditions.

NOTE THESE FIGURES

Filament Volts	2.0
Filament Amps	0.2
Amplification factor	15
Impedance	3,900 ohms
Mutual conductance	3.85 MA/volt.
Anode Volts	150 (max.)

APPROX. OPERATING DATA

Anode volts	125
Grid bias	4½
Anode current	6 M.A.

10/6

And here are particulars of the NEW P.2. WITH OUTSTANDING CHARACTERISTICS.

1. A genuine super power valve with an amplification factor of 7.5—a figure previously considered impossible!
2. Combining the stage gain of the average SMALL power valve with an output which is adequate for a moving coil speaker.
3. Mutual conductance 3.5 milli-amps per volt.
4. Impedance only 2,150 ohms, ensuring reproduction of ample volume and perfect quality.
5. Ideal for the moving coil enthusiast who requires 6 volt results from 2 volt equipment.
6. Minimum current consumption compatible with highest efficiency—a most important point to the listener with battery equipment.

NOTE THESE FIGURES.

Filament volts	2.0
Filament amps.	0.2
Amplification factor	7.5
Impedance	2,150 Ohms
Mutual conductance	3.5 MA/volt.
Anode volts	150 (max.)

APPROX. OPERATING DATA:-

Anode volts	125
Grid Bias	-9
Anode current	12.5 M.A.

PRICE 13/6

G. Marconi

USE THE VALVES THE EXPERTS USE!

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

European Broadcasting Problem.

FOR some years past we have become accustomed to look upon the United States as being in the unfavourable position of having an over-congested ether with innumerable broadcasting stations so closely related, both geographically and in the matter of their kilocycle separation, as to cause mutual interference, and we have been inclined to regard ourselves in this country, and in Europe generally, as more fortunate because the number of stations was more limited. But at the rate at which progress—if we can so term it—is being made in Europe, it is becoming more and more apparent that conditions here are not so happy as we were formerly disposed to believe, and, in fact, there is a serious risk that reception conditions in the Continent of Europe will degenerate into something very much worse than has ever been experienced in the United States.

The reason for this pending calamity is not far to seek, for although we have an international understanding, so to speak, in Europe on various matters connected with broadcast development, we have no central body which is really in the position of being able to *dictate* and *control*, and, moreover, there are still certain countries which do not even respond to the recommendations of our European Broadcasting Conferences. In the United States, on the other hand, there is, after all, one central authority appointed by the United States Government, and disobedient or inefficient transmitters can be prohibited from broadcasting without much formality, so that, however numerous may be the individual stations and individual controls, there is the central body with dictatorial authority. In the States, too, the possibility of friction due to disagreement on political issues between two nations does not come into the picture.

Just recently we have had instances of the sort of trouble which may be expected to occur more frequently in Europe in the future, and these warnings should be sufficient to give great concern to the authorities involved. We have had within the last few weeks the first experience of really serious interference caused by the German high-power station, Muhlacker, interfering with one of our own transmissions because of the close proximity of the two wavelengths, and it is only because of the happy relations existing between the German and British broadcasting authorities that there is no need to anticipate that this difficulty cannot be quickly overcome. If relations were not so friendly, matters might be quite different. Again, without entering into a discussion of politics, we have had the instance of a broadcast from one country being interpreted as unfriendly to another country, resulting in the necessity for a protest.

These incidents, trivial as they may seem at the moment, may foreshadow more serious troubles in the future, unless more satisfactory arrangements can be entered into whereby the international aspects of broadcasting are more adequately controlled.

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THE INTERMEDIATE FREQUENCY AMPLIFIER OF THE SUPERHETERODYNE.
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BON MARCHÉ SCREENED GRID EIGHT.
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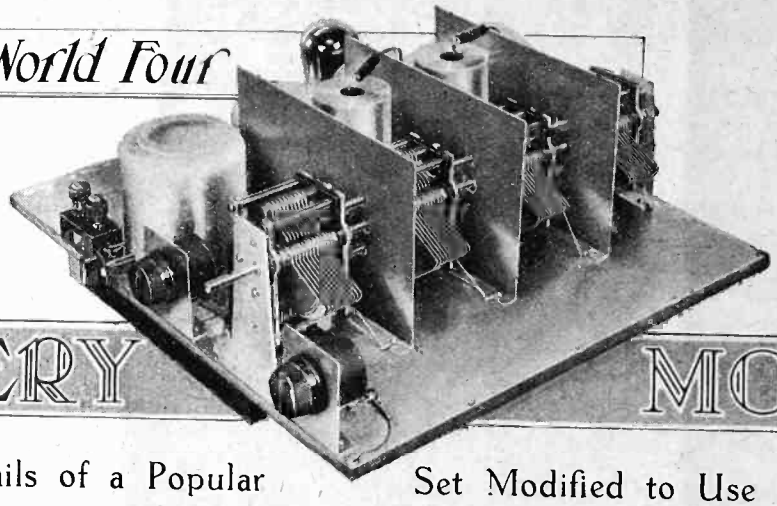
Wireless World Four



BATTERY MODEL

Constructional Details of a Popular Set Modified to Use Battery Valves.

By F. H. HAYNES.

NOT long ago it was customary to design sets for battery working, indicating later, modifications necessary for mains conversion. This procedure is now reversed, and the Wireless World Four* which was developed as an all-A.C. set is now described for use with batteries. The revised design is suited for use where the supply is D.C. Conversion from this modified design back to the original all-A.C. set has been taken into account, so that when the A.C. supply is eventually available the set can be rebuilt as an A.C. model with the minimum of trouble, and making use of most of the existing components. It is unnecessary here to repeat the various considerations leading up to the adoption of the circuit and the specification as given for the original set which are retained in all respects excepting in regard to mains operation. Removal of the mains equipment has been the aim in the present design, making as little change as possible to the values of the remaining components. Certain changes are unavoidable.

SPECIFICATION.

Selective band-pass tuning. Single dial control without trimming condensers.
Pre-H.F. volume control. Critical regulation of regeneration at point of maximum amplification.
Complete coil and valve screening. All H.F. above baseboard with distribution circuits immediately beneath.
Tuned grid intervalve couplings. Ganged wave change switching. Distortionless power grid detection. Compensated pentode output. Complete smoothing and decoupling with a minimum of apparatus.
Readily convertible for all-A.C. mains operation. 2v. battery valves. 180 volts. H.T. Total H.T. current 30 mA.
Provision for gramophone and designed for housing in a standard radio-gramophone cabinet.
Easy access to all components and straightforward wiring so that but few leads appear above the baseboard.
No components to be home constructed. Lowest possible cost.

Indirectly heated valves give superior performance to battery types, and a careful selection of valves has been made in this battery model so that the results may be comparable with those of the mains-operated set. Unfortunately the best H.F. valves fall in the two-volt class, while output valves are best chosen from among those having six-volt filaments. The set might have been arranged to combine the use of both two-volt and six-volt filamented valves, but this would prove either wasteful with L.T. battery power, or unduly complicated as a result of running the first three valves with their filaments in series, while the use of a generous six volt power output valve would result in an excessive discharge rate from an H.T. battery.

In order to make the distant-station-getting properties of the receiver as great as possible the coils have been modified. Whereas tapping points were provided in the A.C. set at several turns down from the top of the coils in order to prevent regeneration, connection from the valve anodes is now made to the top of the coils owing to the fact that the residual grid-to-anode capacity of the valves used is somewhat lower than was the case with the mains valves. With this modification the amplifier is still perfectly stable, and the amplification may yet be further increased before the full effects of regeneration are obtained. To effect this the size of the coils has been increased so that the inductance value when under the screening covers becomes 200 microhenrys as against 160 microhenrys.

Stray capacities in the tuned circuits balance out very well, and are sufficiently close for all condensers to be lined up and the use of trimmers avoided. It is only by omitting trimming condensers that these coils of high inductance can be used, as the throwing of a small fixed capacity across a coil will considerably raise the wavelength obtained at the zero of the tuning dial. The lead to the power grid detector is taken from a point near the centre of the coil, not only to prevent the tuned grid circuit being unduly loaded by the detector, but to reduce the amount of capacity which the detector throws on to this circuit. The position of the tapping point was fixed from considerations of ganging. It is not unduly difficult to convert the coil windings, in the event of changing over to the A.C. model, by removing the excess number of turns and making the required tapping points by slipping a piece of mica under the turn to be tapped and soldering on a lead. The tuning range of the coils is from 200 to about 630 metres, and on a 100 division dial 300 metres falls at

* In the issues dated October 15th and 22nd, 1930.

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Battery Model.—

36, 400 metres at 56, 500 metres at 74, 550 metres at 83, and 600 metres at 90.

Fortunately it is permissible to adopt the same values of feed resistances in the anodes and screens of the H.F. valves. Owing to the lower maximum anode voltage the fixed resistance in the screen volts control has been reduced, while the value of the potentiometer has been increased in order that it may pass but little current. Grid-bias in the H.F. stages is by 0.9 volt cell, the potential being fed through 1 megohm resistances so that grid current, due to overloading of the H.F. valves, increases the negativeness of the grids by the voltage drop through these high resistances.

Detector requirements fix the minimum value of H.T. potential that can be adopted for this set. Power grid detection demands a high voltage at the anode of the detector valve together with generous decoupling. Filter feeding of the L.F. transformer is desirable so that both feed and decoupling resistances are necessary. Lower values of feed and decoupling resistances to those shown cannot be adopted, and these result in the throwing away of about 80 volts. Thus the maximum H.T. potential has been assessed at 180 volts derived from three 60 or two 90-volt batteries. This value is equally suited for use with D.C. supply, in that some 20 volts is invariably lost in smoothing.

Owing to the absence of A.C. ripple potentials the value of the feed condenser to the primary of the inter-valve transformer has been increased to the normal value. The arrangement of the pentode output is normal, although it has been necessary to introduce a feed resistance of 1,500 ohms and to reduce the value of the resistance in the pentode screen lead to 5,000 ohms.

Constructional details already having been given at length reference should be made to the original article as well as the practical hints and tips in last week's issue. In that the various types of screen grid valves vary in their overall dimensions valve screens cannot be standardised, and adaptors have been made to reach down to the lower anode terminals of the battery valves. A modification in the type of condensers used in association with the coils removes the danger of contact between fixed condenser terminals and coil-screening covers.

Current and Voltage Values.

As a guide to fault finding the value of the current passing in the various paths from the H.T. battery is as follows:

H.F. anodes, 2.5 mA., when 180 volts is applied at the H.T. terminals. This gives 120 volts at the anodes.

Screen voltage potentiometer with contact arm lifted, or with H.F. valves removed and measured on the earth side, 2.6 mA.

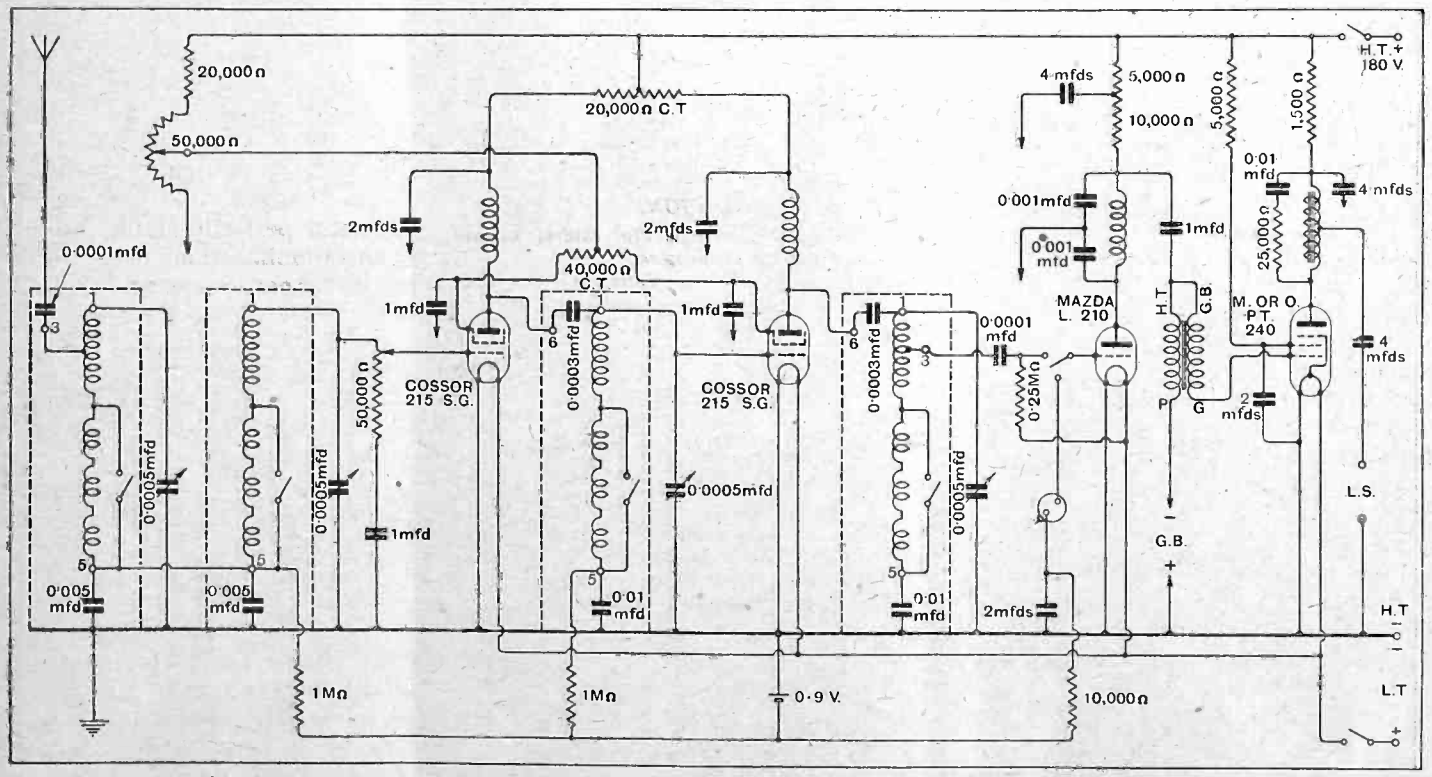
In the lead to the two screens, 1.6 mA. or 0.8 mA. to each valve.

Average detector current, 6 mA.

Pentode anode current, at 9 volts bias, 12 mA., so that about 5 volts are dropped in the 450 ohm choke, and nearly 20 volts in the 1,500 ohm resistance, thus giving 155 volts at the anode.

Pentode screen current 3.8 mA.

These currents total up to about 30 mA., representing the load taken from the H.T. battery. Some economy in H.T. current has been effected by slightly reducing



As far as possible the values given for the various components have been retained permitting of easy conversion for use with A.C. supply. The types of valves used are indicated.

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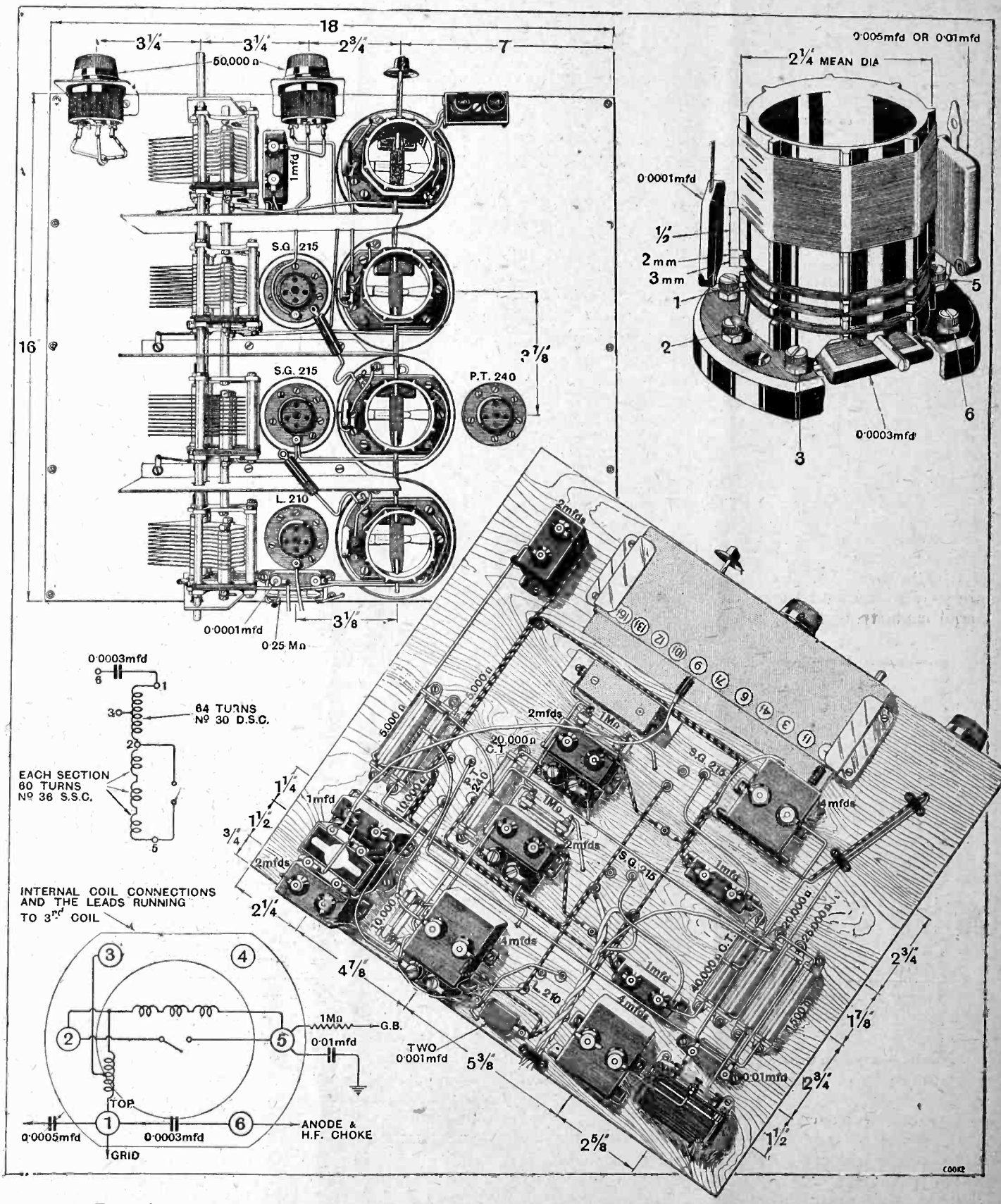

Top and underside views of the chassis baseboard giving all essential dimensions for positioning the components.

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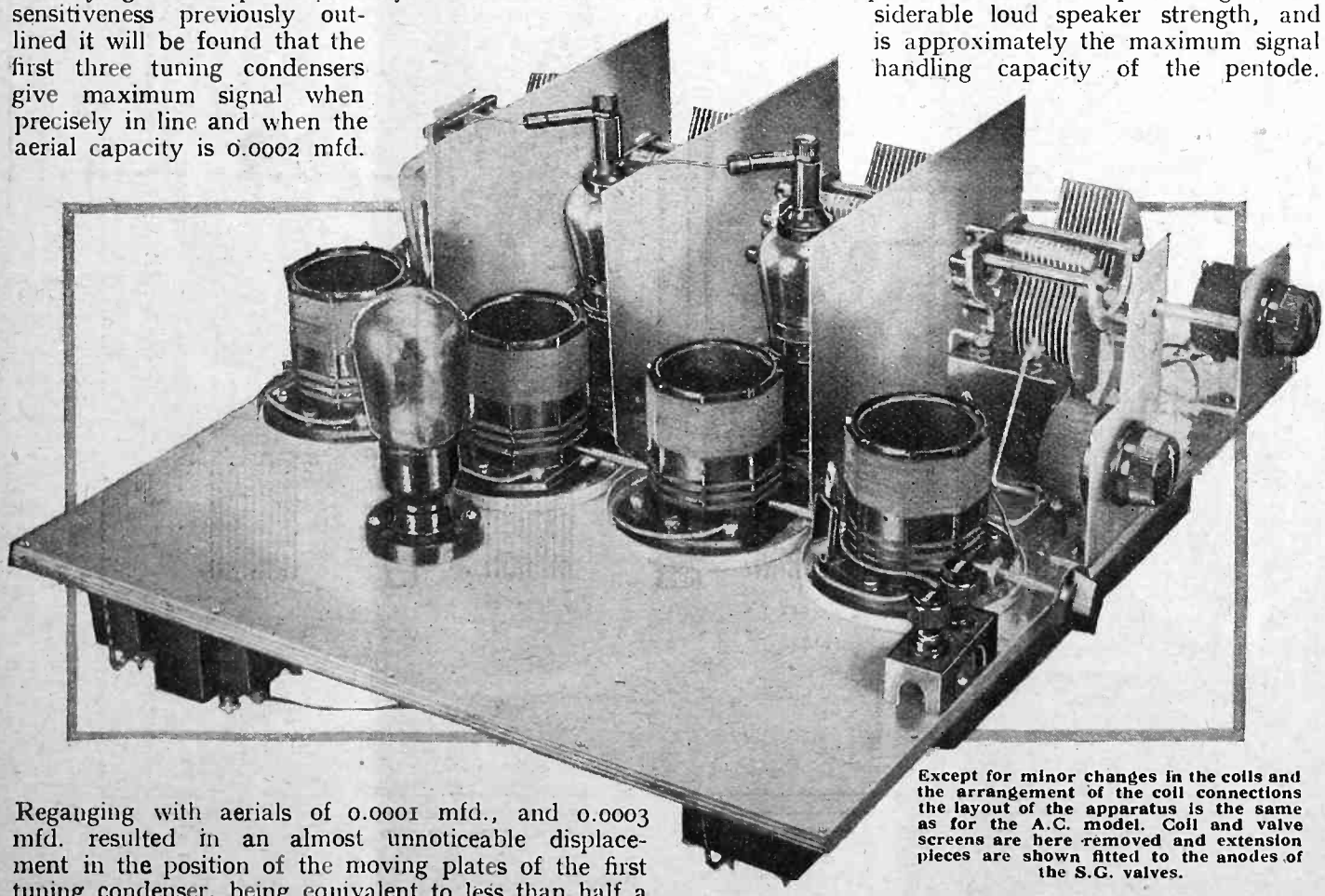
LIST OF PARTS.

2 Potentiometers, 50,000 ohms (Colvern).
1 Resistance, 20,000 ohms (Colvern).
1 Resistance, 20,000 ohms C.T. (Colvern).
1 Resistance, 40,000 ohms C.T. (Colvern).
1 Resistance, 25,000 ohms (Colvern).
1 Resistance, 15,000 ohms, tapped 5,000 ohms (Colvern).
1 Resistance, 5,000 ohms (Colvern).
1 Resistance, 1,500 ohms (Colvern).
3 Fixed condensers, 4 mfds., 400 volts D.C. test (T.C.C., Type 61).
4 Fixed condensers, 2 mfds., 400 volts D.C. test (T.C.C., Type 50).
4 Fixed condensers, 1 mfd., 400 volts D.C. test (T.C.C., Type 50).
1 Fixed condenser, 0.0001 mfd., mica (T.C.C., Type 34).
2 Fixed condensers, 0.005 mfd. (T.C.C., Type M).
2 Fixed condensers, 0.01 mfd. (T.C.C., Type M).
2 Fixed condensers, 0.001 mfd. (T.C.C., Type M).
1 Fixed condenser, 0.0001 mfd. (T.C.C., Type M).
1 Fixed condenser, 0.01 mfd., 400 volts D.C. test (T.C.C., Type 40).
4 Coils (Colvern, TGB).
4 Coil Screens (Colvern CCS).
2 Grid leaks, 1 megohm (Loewe).
1 Grid leak, 0.25 megohm (Loewe).
1 Grid leak, 0.01 megohm (Loewe).
4 Porcelain grid leak holders (Bulgin).
3 H.F. chokes (McMichael, Binocular Junior).
1 Variable condenser, ganged four-section each 0.0005 mfd. (Cyldon).
1 Two-pole switch in battery leads (Colvern, S.2).
2 Valve screens (Loud Speaker Co., Ltd.).
4 Valve holders, five-pin without side tags (W.B.).
1 L.F. choke (R.I. Pentomite).
1 L.F. transformer (R.I. Hypermu).
1 Grid cell, 0.9 volt (Siemens).
1 Grid bias battery, 16½ volts (Siemens, G3).
1 Reduction gear dial (Burndept, Ethovernier).
1 Terminal block (Belling Lee).
2 Ebonite shrouded terminals A and E (Belling Lee).
2 Wander plugs (Clix).
2 Hook terminals (Clix).
2 Anode connectors (Clix).
Sleeving, wood, tin, wire, flex, screws, etc.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed, and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

the screen potential of the pentode, this having been adjusted to the point where grid current is just avoided when the second H.F. valve is fully loaded and the signal limiting effect of the feed resistance in the grid of the screen-grid valve takes effect.

Carrying out the process of adjustment to maximum sensitiveness previously outlined it will be found that the first three tuning condensers give maximum signal when precisely in line and when the aerial capacity is 0.0002 mfd.



Except for minor changes in the coils and the arrangement of the coil connections the layout of the apparatus is the same as for the A.C. model. Coil and valve screens are here removed and extension pieces are shown fitted to the anodes of the S.G. valves.

Reganging with aerials of 0.0001 mfd., and 0.0003 mfd. resulted in an almost unnoticeable displacement in the position of the moving plates of the first tuning condenser, being equivalent to less than half a division in the middle of the scale. Interchanging various detector valves resulted in a maximum displacement at the centre of the scale of 1½ divisions, so that one can safely accept the working condition of all condensers in line, though testing for individual ganging is a good way of revealing faults.

Testing the receiver on a 40ft. aerial reception from Budapest gave 450 milliwatts output into a 4,000 ohm load on the output terminals, this representing a considerable loud speaker strength, and is approximately the maximum signal handling capacity of the pentode.

This was produced by a fall in the detector current due to the signal of 0.25 mA. By feeding a signal directly into the detector normally passing 6.4 mA. it was found

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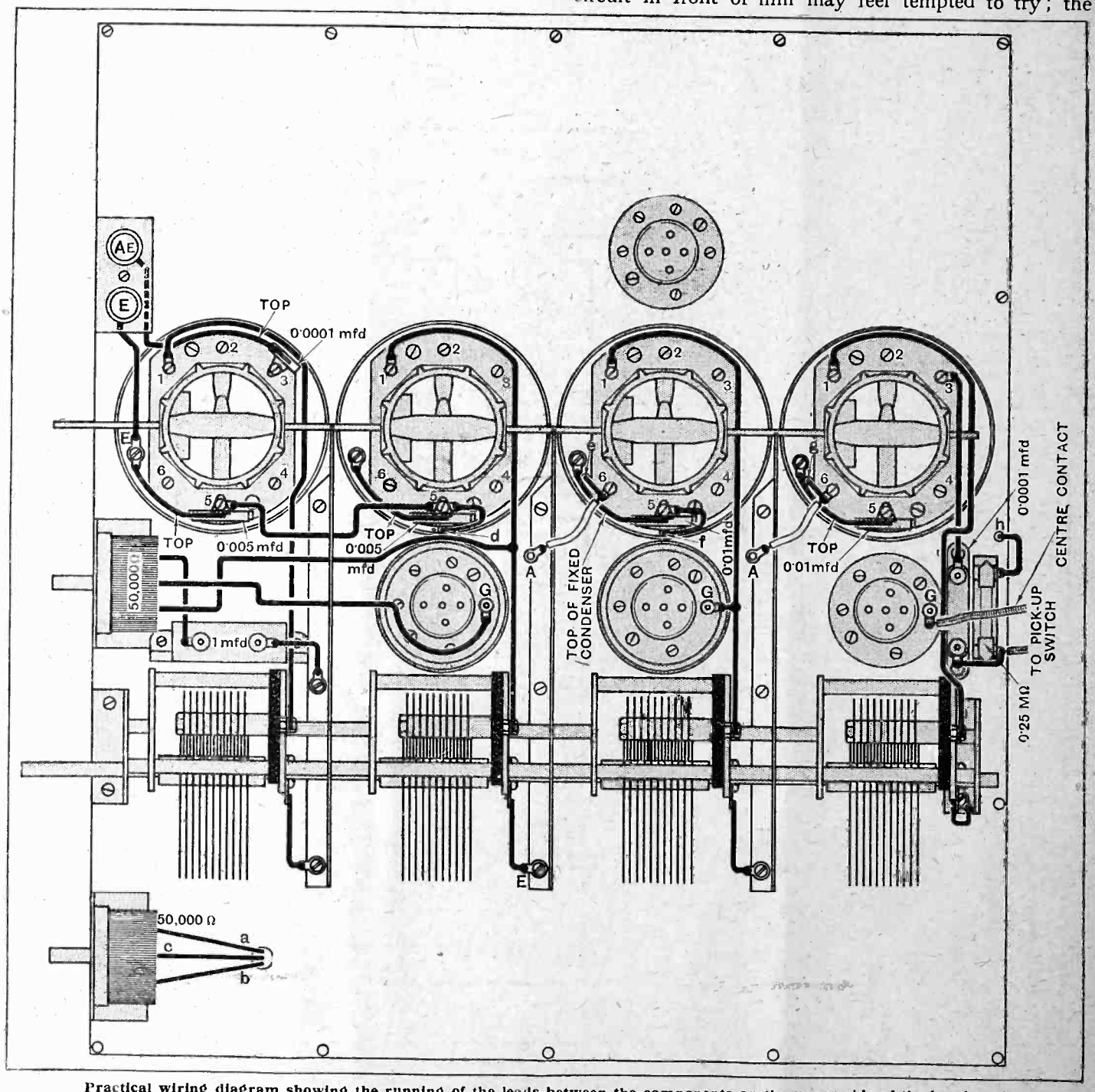
Battery Model.—

that the pentode gave grid current when the reading dropped to 5.5 mA., this information being helpful to those who are in the habit of using a 10 mA. meter in the anode circuit of the detector. Such a meter should be connected in the lead running to the 10,000 ohm resistance.

20,000 ohm coupling resistance to each valve that just over 80 volts is the maximum that can be applied to the screens. The optimum value of 70 volts falls near the middle of the potentiometer setting.

Brief reference might be made to another modification which the enthusiast with the Wireless World Four circuit in front of him may feel tempted to try; the



Practical wiring diagram showing the running of the leads between the components on the upper side of the baseboard.

Screen voltage control conveniently adjusts regeneration, for it will be seen that with 4.2 mA. through the 20,000 ohm resistance in series with screen-grid potentiometer about 80. volts is dropped, and with another 16 volts lost as a result of 0.8 mA. passing through the

ready conversion of the set to make use of three H.F. stages. This is done by substituting 0.01 mfd. condensers for the 0.005 mfd. condensers fitted in the first two tuned stages and wiring in another screen grid valve between the two coils exactly as is done in subsequent

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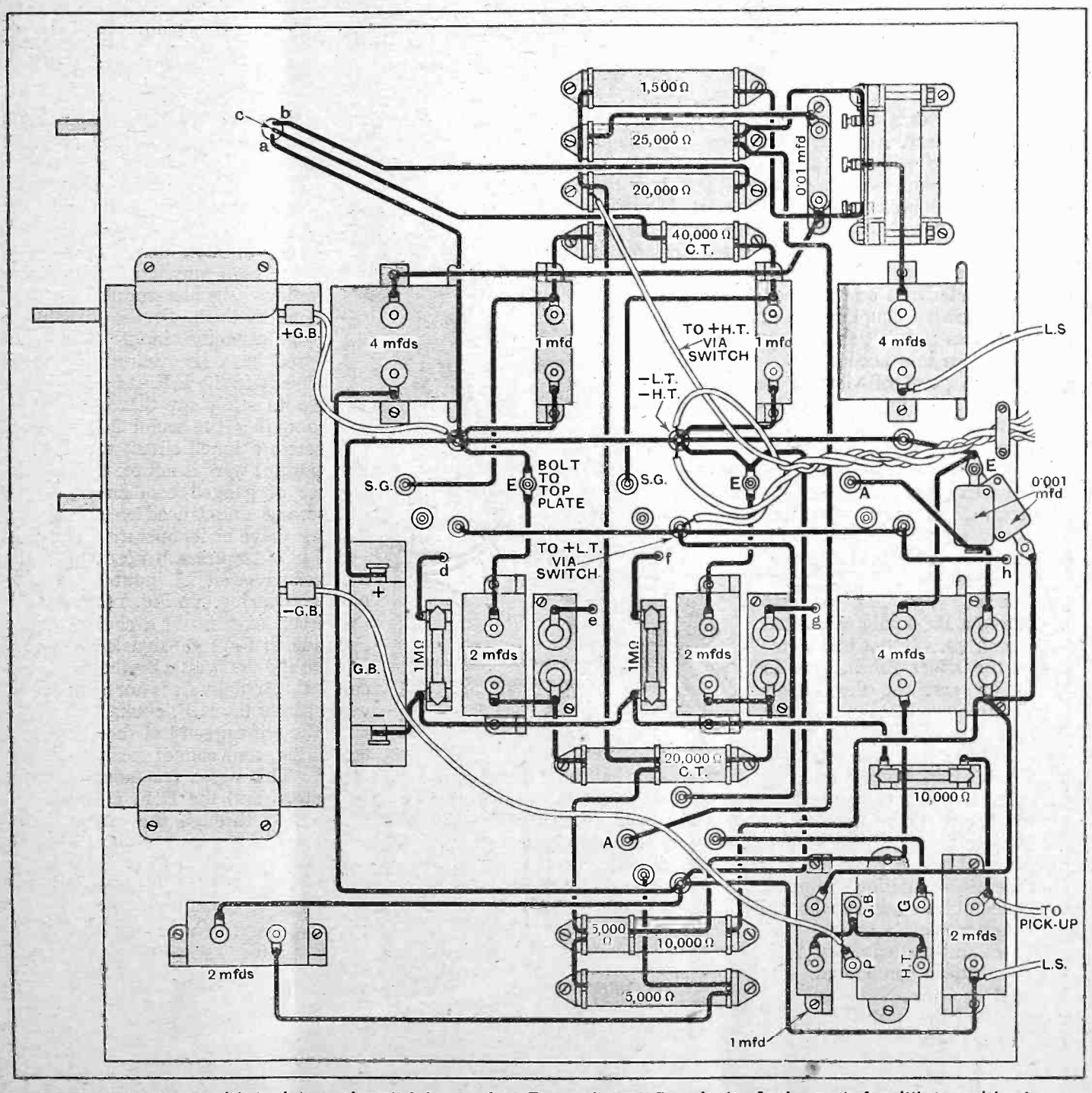
Battery Model.—

stages. Regeneration is adjusted by tapping down the lead from the feed condensers between each stage to a point near the middle of the coils, which is easily carried out by lifting the turn to which the connection is to be soldered and slipping in a piece of mica. Used with a small aerial of some 20ft., the three H.F. stage set will completely separate stations 8 kilocycles apart, while 54 stations have been tuned in on a single rotation of the dial on the broadcast band. Screen grid voltage control will, however, need to be operated in conjunction with the tuning dial, as the tendency to regenerate declines with increase in the capacity of the tuning condenser. Many suggestions have been made by way of modifying the radio gramophone assembly as originally described, and it is learned that the Carrington Manufacturing Company have produced a table model cabinet to accommodate receivers of the Wireless World Four class. (*The Battery Model Wireless World Four can be inspected at* 116, *Fleet Street, London, E.C.*4.)



The under baseboard wiring. A two-pole switch breaks the L.T. + and the H.T. + leads. In the event of omitting provision for gramophone pick-up the grid condenser is joined directly to the point G on the top side of the baseboard, while the 2 mfd. condenser and 10,000 ohm leak shown in the bottom right hand corner of this diagram are no longer required.

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Interesting Valve Development

Amplification and Detection with an Experimental Low-impedance Screened Valve.

By W. I. G. PAGE, B.Sc.

ELEVEN years ago an American physicist named Miller wrote a paper describing a phenomenon connected with the three-electrode valve, which is still of fundamental importance and has become known as the "Miller Effect." The article referred to explains the cause and effect of the input impedance of a valve, and shows that any simple calculation of stage gain based on a knowledge of the valve characteristics and the constants of the intervalve couplings is practically worthless unless this all-important effect is taken into account.

From the point of view of forming a condenser, the input electrodes of a valve, that is, the grid and filament, look innocent enough; in fact, measurement shows the likely static capacity between them to be about 5 micromicrofarads. However, when the valve is actually amplifying, for instance, in an L.F. resistance-coupled stage, the harmless 5 micromicrofarads may become 250 $\mu\mu f$ (0.00025 mfd.), and a stage gain calculated to be, say, 20, without consideration of the Miller Effect, may in reality be zero at the higher audible frequencies due to the shunting effect of the extra capacity. This is only one example of input impedance and its important effect.

Experimental valve of low A.C. resistance and negligible input impedance. It contains the screening of a screen grid valve and a third earthed grid as used in a pentode.

Every valve in a receiver, due to its amplifying action and to the presence of internal anode-grid capacity, has an input impedance—the small condenser formed by the grid and anode provides an A.C. path back to the input for the alternating component in the anode circuit. As a generalisation it can be said that across the grid and filament of a valve there is always a capacity and a resistance component representing the Miller Effect, which, unfortunately, cannot be anticipated from an examination of the values of the coupling components shown in an ordinary circuit diagram. The resistance component is negative, that is to say, there is a reaction effect on the input if the anode load is inductive, and an anti-reaction or damping effect if the anode load is capacitative, and it must be remembered that the input capacity is present whichever sign is taken by the resistance component.

SUCH limitations are imposed on amplification and detection by the input impedance of the three-electrode and pentode valves that it was thought worth while to conduct some experiments with a screen grid valve of low impedance. A specially designed valve has been constructed for "The Wireless World" having a third grid to allow high screen voltages without secondary emission effects. In addition to interesting results in aperiodic H.F. amplification and detection, it appears that one of the most important uses of such a valve is in a tuned H.F. stage where the chances of cross-modulation are very considerably reduced owing to the large available grid swing.

In low-frequency amplifiers the resistance component is of the order of 5 to 10 megohms, and can be neglected, but in high-frequency stages and detectors using triodes this resistance may be sufficiently high to modify profoundly the performance of the receiver, and may, in fact, cause a valve of quite high amplification factor to reduce signals rather than to amplify them. On the other hand, the capacity input component produces its harmful effects chiefly in the L.F. stages, and one could safely say that in the H.F. amplifier the small added capacity across a tuned circuit was entirely unimportant were it not for the increasing use of ganged condensers, which can become unbalanced on changing a detector valve or its operating voltages.

A few examples will no doubt make the serious effect of input impedance more convincing. In Fig. 1 (*a*) is shown the circuit diagram of a choke-coupled aperiodic H.F. stage, signals being supplied to the first valve by the tuned circuit L.C. Actually C_1 is not a condenser wired across the H.F. choke, but represents the self-capacity of the choke and the wiring, and cannot easily be made less than, say, 20 $\mu\mu f$. This has a reactance of about 8,000 ohms at 300 metres, and the H.F. currents will prefer this path to passing through the much higher reactance of the choke. The anode load is, therefore, capacitative, and by the rule given earlier the input impedance will consist of a small capacity, which will alter the tuning condenser C only by a degree or so, and of a positive resistance (or negative reaction element) across the tuned circuit L.C. Measurements of this load have been taken by A. L. M. Sowerby and published in a recent article entitled "Aperiodic H.F. Amplification."

A typical modern triode was found to have a damping effect equivalent to shunting the input by about 5,000 ohms, so that if L.C. were designed to possess a dynamic resistance of 120,000 ohms at resonance, this would actually drop to something over 9,500 ohms when followed by the aperiodic stage. Obviously, due to

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Interesting Valve Development.—

input impedance, signals would be greater if the stage were omitted, unless reaction were deliberately used and pressed to the limit.

The case of the L.F. resistance amplifier is shown in Fig. 1 (*b*). Here we neglect the resistance component of the input impedance and only consider the capacity effect. Assuming the *effective* amplification A of V_2 to be 20, and its anode-grid capacity to be 10 $\mu\mu f$, then the working capacity between grid and filament represented as C_g becomes $(A+1)10\,\mu\mu f = 210\,\mu\mu f$. This is shunted across the anode load R_1 of the preceding valve V_1, which already has its own parallel capacities C_a. At low frequencies, signal voltages will be built up across R_1 and amplified in the usual way, but at the higher speech frequencies C_a will reduce the total anode load to a very low figure, and signals will be lost. Here, again, stage amplification is seriously limited by input impedance, since A—the effective amplification—must be maintained as low as possible to keep the capacity of C_a small.

The pentode, in spite of its earthed grid, has quite a large anode-grid capacity, and was shown by John Harmon[1] to possess an input impedance C_o (capacity component) of about 90 $\mu\mu f$ (see Fig. 1 (*c*)). If this valve is preceded by a transformer of ratio N, there will be shunted across the primary a capacity N^2C_o, or, in the case of a 6 to 1 step-up ratio, no less than 3,000 $\mu\mu f$, or 0.003 mfd. Transformers are generally designed to a specification, which includes a certain maximum shunted capacity, but certainly not such a high figure as this which is likely to upset the frequency-response characteristic.

Detectors which, under working conditions, have a high-frequency component in both grid and anode circuits must be considered as H.F. valves from the point of view of input impedance. The load on the grid is always of the positive kind, which damps the tuned circuit, because the anode load, be it a transformer, choke, or resistance, is always capacitative as far as H.F. is concerned. Fig. 2 shows the input load with change of signal strength for a typical three-electrode anode-bend detector.[2] It is evident that, due to anode-grid capacity, the input impedance is greater the weaker the signal. This is one of the reasons why this type of detector is not popular for distant station reception. The distortionless rectifying properties of the power-grid detector would be even more attractive if less input damping existed. It was shown by W. T. Cocking[3] that the input load of an AC/HL valve acting as a high-voltage grid detector was as low as 50,000 ohms (see Fig. 3), although that due to grid current and other losses was only about 200,000 ohms. In the same way a conventional leaky-grid detector damps its preceding tuned circuit more by reason of input impedance than by the flow of grid current.

So far we have avoided the tuned H.F. stage where the input impedance takes the form of negative resistance and causes self-oscillation as soon as the circuit losses are reduced to zero. Because of this effect, a stable amplification with triodes of only about two per stage was possible until the advent of the neutralised circuit, and later the screen-grid valve. Summarising, we can say that, although eleven years have elapsed since the undesirable effects discovered by Miller were pointed out, only for one special function—namely, tuned H.F.—has a valve been produced with a negligible input impedance. We are still left with anode-bend, leaky-grid, and power-grid detectors, which damp the input and reduce selectivity; with resistance-coupled stages in which the stage gain must be made very low, otherwise high notes will be lost; with pentodes which throw back harmful capacities across the L.F. transformers preceding them, and with no single valve which will amplify satisfactorily in an aperiodic H.F. stage.

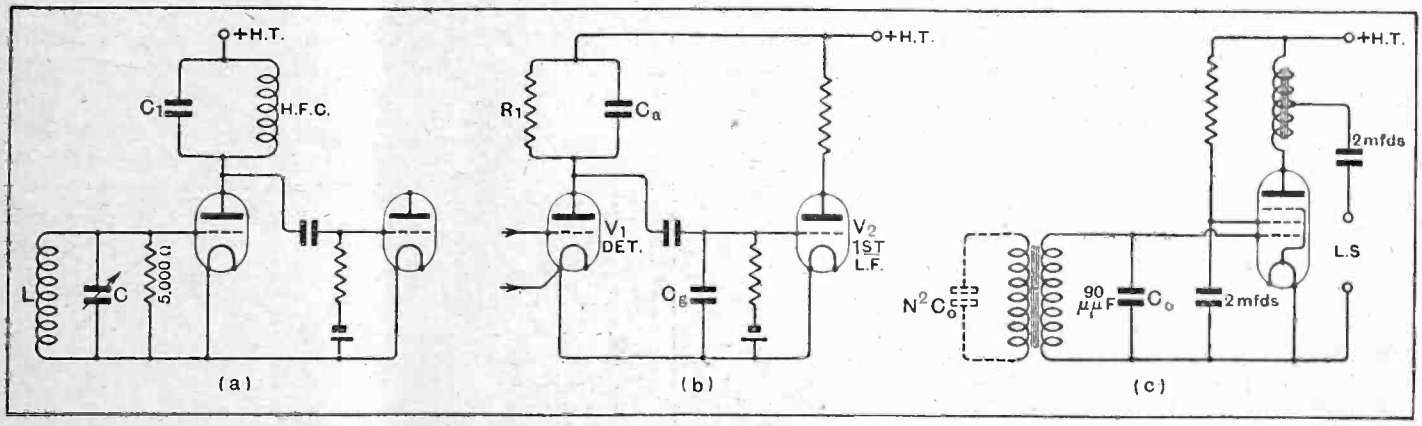

Fig. 1.—Showing the effect of input impedance with various valves. (a) Aperiodic H.F. amplification; the tuned circuit may become loaded with a shunt of 5,000 ohms. (b) Low-frequency resistance coupling in which high notes will be lost unless the stage gain is kept low. (c) A transformer-coupled power pentode which may throw a very large capacity component across the primary winding.

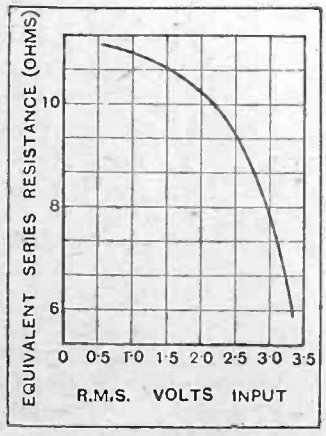

Fig. 2.—Variations of equivalent series resistance of a typical anode-bend detector with signal strength. Due chiefly to input impedance, this type of rectifier is insensitive to weak signals.

[1] See "Quality Reception," *The Wireless World*, October 15th, 1930.

[2] See "Improving Detector Efficiency," by W. B. Medlam. *The Wireless World*, May 22nd, 1929.

[3] "Detector Damping," *The Wireless World*, July 30th, 1930.

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Interesting Valve Development.—

It was felt that it would be worth while to try some experiments with a low-impedance screened valve, so that the various forms of detection and amplification already discussed could be carried out without the limitations imposed by input impedance. The possibilities of such a valve were mentioned in casual conversation to Mr. E. Y. Robinson, of the Mazda Valve Laboratories, who kindly consented to design a few specimens having the screening arrangements of the AC/SG, and a third grid as in the AC/PEN. Inter-electrode capacity between anode and grid has been estimated at about 0.05 $\mu\mu f$, and the input impedance (H.F. positive resistance component) was measured to be 500,000 ohms—a negligible shunt across a tuned circuit. For power detection and L.F. amplification quite large grid swings are likely to be handled, and as these require high screen voltages it was found necessary to avoid any region of negative resistance by having a third grid at earth potential.

Screen-Grid Valve Without Cross-modulation.

Employed in a two-stage aperiodic H.F. amplifier with a triple-gang pre-selector, two of these valves gave an overall stage gain of rather more than 100—a greater amplification than could be obtained from any two ordinary S.G. valves on the market. The selectivity was reasonably good, and the quality of reproduction excellent. Any further development in this direction would

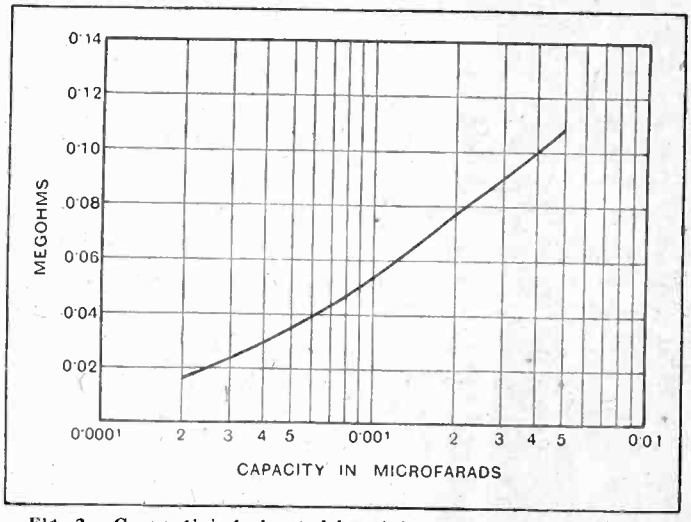

Fig. 3.—Curve giving shunted input impedance of an AC/HL. valve acting as power-grid detector. With an 0.001 mfd. anode shunting condenser the damping of 50,000 ohms is serious. The load due to grid current is only 200,000 ohms.

seem to be in designing valves of even lower A.C. resistance and paying special attention to stray capacities. As a power-grid detector, one found that the valve was highly sensitive and that the selectivity of the preceding tuned circuit was not impaired. The absence of input impedance in this case should be of importance where ganged tuning is used. Resistance coupling and anode-bend detection were not attempted, because the valves, as at present designed, passed rather too heavy an anode current. With full screen and anode volts the valve becomes a screened pentode having negligible input impedance. Why is not the anode of an ordinary pentode brought to the top of the bulb?

Perhaps the most interesting use of the valve is in a tuned H.F. stage, for, owing to the absence of a negative resistance "kink" (which is shown as a shaded area in Fig. 4 for a normal type of S.G. valve) and to

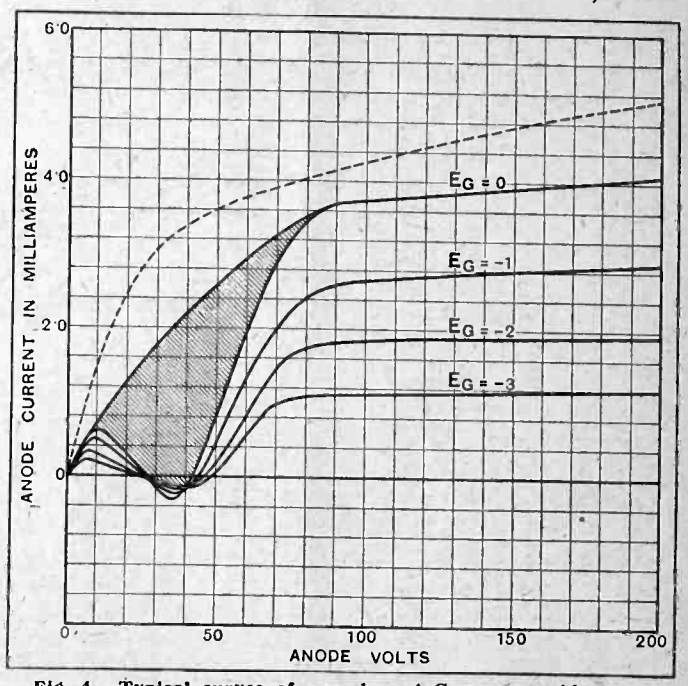

Fig. 4.—Typical curves of a modern A.C. screen-grid valve. The negative resistance or secondary emission area is shaded. The dotted curve gives the desirable $E_g = 0$ characteristic for a low-impedance screened valve with a third grid. The increased grid swing minimises the risk of cross-modulation.

the lower impedance, a very much larger grid swing can be handled without rectification or cross-modulation. Furthermore, screen voltage is not critical, and oscillation does not take place when the screen voltage approaches the anode voltage. It would seem accidental that modern screen-grid valves have A.C. resistances from 200,000 to 1,000,000 ohms. It must have been assumed that these valves would be used with the tuned anode scheme where the whole impedance of the coupling is in the anode circuit. Many designers wishing to make use of the more attractive properties of transformers have found that although a step-down ratio gives optimum coupling according to theory, actually a step-up ratio is required to give anything like adequate selectivity. The result is a somewhat chaotic situation, in which signal strength is thrown away by the use of couplings with various non-optimum ratios, and valve curvature results from high A.C. resistance.

The dotted line in Fig. 4 gives the type of curve to be expected with a low-impedance screened valve having a third grid. There is less risk of cross-modulation due to increased grid swing, and if residual electrode capacity can be made negligible there should be quite a wide application both in detecting and amplifying stages. With a valve of 50,000 ohms A.C. resistance in a tuned H.F. stage where the dynamic resistance R of the secondary of the transformer was 120,000 ohms, the optimum ratio N would be $\sqrt{R/R_o} = 1.55$ to 1 step-up, and the stage gain $\frac{1}{2}\mu N = 116$, assuming a mutual conductance of 3. Selectivity should be improved appreciably both on the input and output sides.

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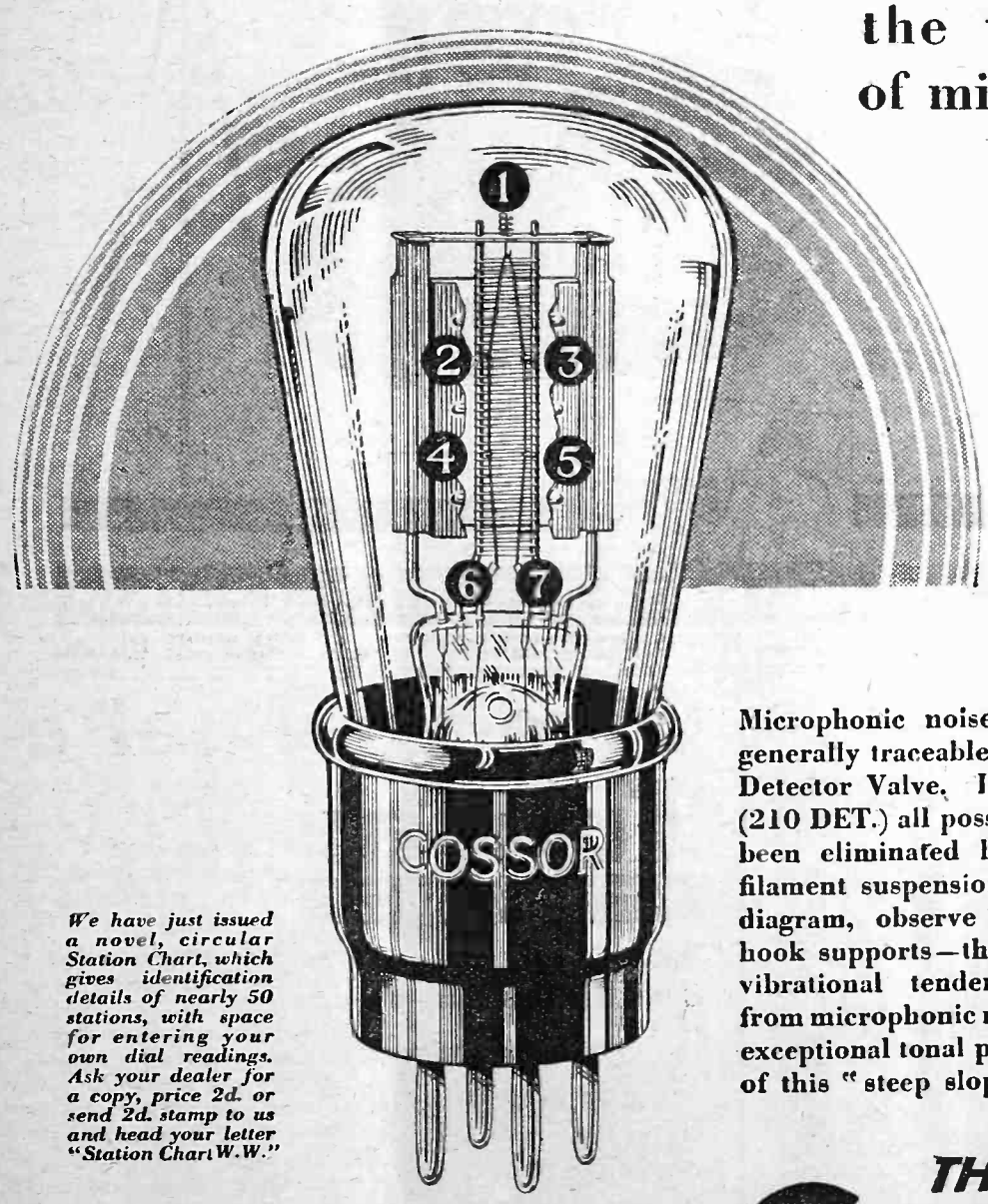
Seven point suspension

definitely prevents filament vibration

the primary cause of microphonic noises



Microphonic noises in a Receiving Set are generally traceable to filament vibration in the Detector Valve. In the new Cossor Detector (210 DET.) all possibility of this vibration has been eliminated by the special seven point filament suspension employed. Examine the diagram, observe the four *extra* insulated hook supports—these effectively damp out all vibrational tendencies. Complete freedom from microphonic noises and great volume with exceptional tonal purity are ensured by the use of this "steep slope" Cossor Detector Valve.

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Cossor 210 DET., 2 volts, .1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1.15 m.a./v. Normal working Anode Voltage 90-150. *Price* 8/6

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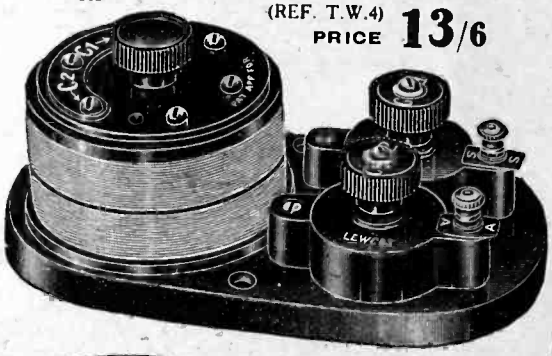
can easily be eliminated by the turn of a switch with the

LEWCOS TWIN REJECTOR WAVETRAP

(REF. T.W.4) PRICE 13/6

THE Lewcos Twin Rejector Wavetrap consists of an inductance coil of Litz wire, two variable condensers and a two-way switch, all mounted together on a neat Bakelite baseboard. It operates successfully with any receiver, and is connected between the aerial and the aerial terminal of the receiver. The two variable condensers and the two-way switch are clearly marked C1 and C2. The method of operation is very simple, and consists of adjusting the condenser C1 to the lower wavelength station, switching over to the C2 position and adjusting C2 to the higher wavelength station. Write for fully descriptive leaflet Ref. R60.



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CURRENT TOPICS

News of the Week in Brief Review.

WHY NOT WEEK-END LICENCES?

For working a wireless set without a licence, George Cashmore, of Chadwick End, near Knowle, has been fined 40s. at the Solihull Police Court. The defendant explained to a Post Office official that the set was used only at the week-ends.

oooo

BIRMINGHAM'S LOUD SPEAKERS.

The Home Office has approved a bylaw for Birmingham forbidding the use of loud speakers in public places to the annoyance of passengers or occupants of any premises.

oooo

THE HIGHEST WIRELESS STATION?

The Wireless World recently recorded the claim of France as possessing the highest wireless station in the world, viz., that on the Pic du Midi (3,000ft.).

"I regret to disillusion them," writes a correspondent in Peru. "The record is held easily by the broadcasting station of La Paz, Bolivia, the world's highest capital, with a height of 10,500ft. above sea level."

France must now think of a crushing reply.

oooo

EDUCATIONAL BROADCASTING IN FRANCE.

After a long interruption the Paris P.T.T. station has resumed the broadcasting of the various lectures of the Sorbonne and the Collège de France. These are said to be much appreciated by the educated classes in Paris.

oooo

GERMANY'S "BIG THREE."

To co-ordinate broadcast programme efforts throughout Germany a Council of Three has been formed, consisting of Dr. Flesch, director of the Berlin Station; Herr Ernst Hardt, of the Cologne-Langenburg stations; and Dr. von Boeckmann, of the Munich station. By joining forces the broadcasting authorities will thus be enabled to give German listeners the widest possible variety of talent with a minimum of overlap.

oooo

WHISPERS FROM MOSCOW.

To its manifold activities at Christmas time the Post Office now adds the exciting task of tuning in Moscow on 1,304 metres on Tuesday to intercept propaganda in English. Shorthand writers attend the P.O. experimental station near St. Albans, and their transcript (if atmospherics, pronunciation, etc., permit of any) is sent direct to the Foreign Office.

oooo

A PERIPATETIC STATION.

Radio-Vitus, Paris, has just terminated another of those spasmodic ether periods which its name goes so far to suggest. The station left its listeners guessing during October but resumed transmissions from a new site at Romainville on November 2nd. Unfortunately, in their eagerness the officials had overlooked the necessity for the Postmaster-General's permit, learning too late of an imminent order to close down. This they anticipated on December 1st, 48 hours before it arrived, and listeners are waiting for the next spasm.

NAVAL WIRELESS PIONEER.

It is stated that Lieut. R. H. W. Westcott, who has died at Dawlish, Devon, was the first wireless warrant officer in the Navy.

oooo

"ULTRA-SHORTS" FOR TELEVISION?

Television experimenters in America are to be allotted the ultra-short wavelengths for their experiments. It is understood that the Federal Radio Commission is consenting to the allocation of 6.97 metres to the Milwaukee Journal, which has already experimented with 13 metres, and intends to discover whether still shorter waves are not more suitable for television.

WHY PARISIANS HATE MÜHLACKER.

The new German station at Mühlacker can be heard perfectly in France, and it is not more welcome on that account writes our Paris correspondent. Owners of unselective sets complain that the station prevents them from hearing Radio Algiers and Barcelona, and that—worst of all—it "makes London almost completely disappear." The Paris Press protests against a super-station on the frontier, describing it as a "nuisance."

oooo

"SMALL ADS." AT CHRISTMAS.

The approach of the Christmas holidays makes it necessary to close for press earlier than usual with our issue of December 31st. Miscellaneous advertisements for inclusion in this issue can be accepted up to the first post on December 22nd.

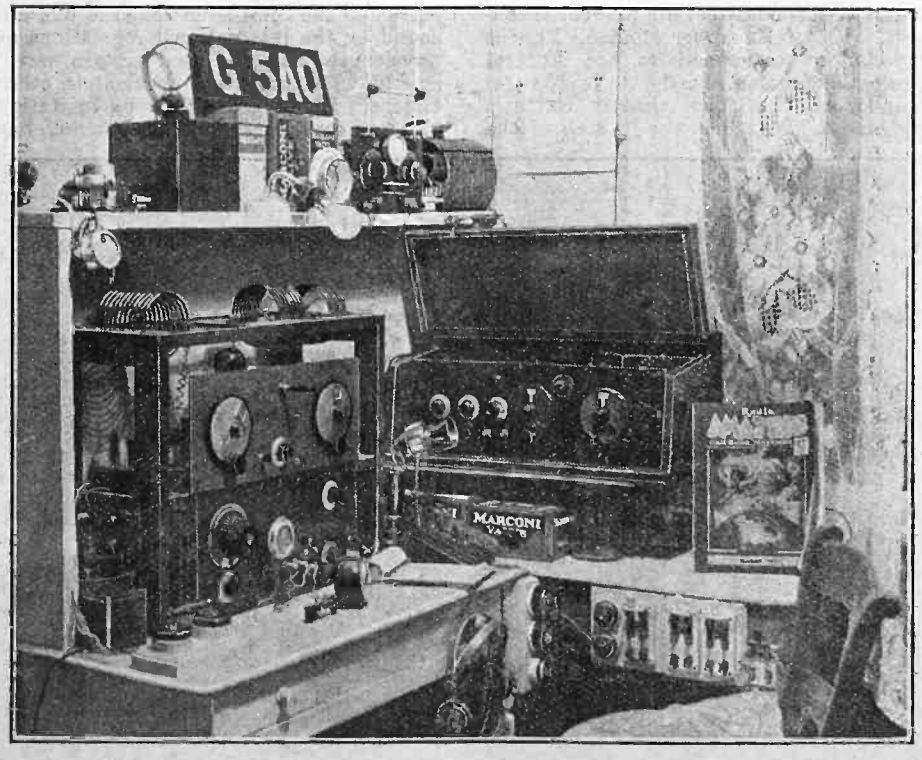
The Wireless World dated December 24th will be on sale on Tuesday, December 23rd.

oooo

PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION.

Wireless instruments will be included in the display at the Twenty-first Annual Exhibition of Electrical, Optical and other Physical Apparatus to be held by the Physical and Optical Societies on January 6th, 7th and 8th next at the Imperial College of Science and Technology, South Kensington.

In addition to the Trade Section, there will be a Research and Experimental Section arranged in three groups: (a) exhibits illustrating the results of recent



AN ACTIVE TRANSMITTER. G5AQ, owned and operated by Mr L. A. Carter at Putland Cottage, Heathfield, Sussex. The 10-watt transmitter consists of a crystal oscillator controlling a TP-TG oscillator. Choke control is used for telephony. The receiver shown is an O-V-2. Up to the end of September 37 countries had been worked on CW and most of Europe on telephony. Mr. Carter works regular schedules (phone and music) every Sunday from 9.30 to 10.0 a.m.

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physical research; (b) lecture experiments in physics; and (c) historical exhibits.

Invitations to the Exhibition have been sent to numerous societies. Those who are not members of a society may obtain tickets on application to the Secretary, 1, Lowther Gardens, Exhibition Road, London, S.W.7. No tickets are required for January 8th.

oooo

EX-R.E. DESPATCH RIDERS.

It is proposed to hold a reunion dinner of ex-R.E. despatch riders early in the New Year. For further details interested readers are asked to communicate with Mr. E. R. Gilbert, Gilbert Advertising, Ltd., 14-18, Holborn, London, E.C.1.

oooo

A PIONEER.

The staffs of the Marconi Associated Companies have marked their appreciation of the services of Mr. Henry W. Allen, who is retiring under the age rule, by presenting him with a radio-gramophone and cabinet with records. The Marchese Marconi, in making the presentation last week, referred to the valuable assistance rendered to him by Mr. Allen when he first visited England in 1896, and in the formation of the Wireless Telegraph and Signal Company (now Marconi's Wireless Telegraph Company) in the following year.

On the formation of that company Mr. Allen received the appointment of secretary, and subsequently he occupied the position of joint general manager and deputy managing director.

oooo

POWER BATTLE IN U.S.

The question of high power broadcasting in America is on the knees of the gods, writes our Washington correspondent. Chief Examiner Ellis A. Yost is expected to recommend to the Federal Radio Commission shortly that the remainder of the four cleared channels designated for high power in each of the five zones, or 20 channels in all, be filled by stations seeking 50 kilowatts which he will designate.

This means that only nine of the 26 applicants for 50 kilowatts will achieve their purpose unless the Commission decides to open up the other four cleared channels in each zone, or 20 more, to high power also. Whether the Commission will do this apparently rests with Congress.

oooo

LONDONA LOUD SPEAKERS.

We learn that Londona permanent magnet loud speakers are now supplied through Londona, Ltd., 66, Hatton Garden, E.C.1. Telephone: Holborn 5713.

oooo

WIRELESS AT WESTMINSTER.

By Our Special Correspondent.

Two Questions.

An important statement on broadcasting was made in the House of Commons last week by the Postmaster-General in response to Capt. Hacking, who said that there had been a good deal of complaint from the south-east of England of interference caused by certain Continental stations. He hoped the Postmaster-General would make representations to those stations that they should use wavelengths which would reduce interference to a minimum. He hoped also that the Postmaster-General would deal with broadcasting from Moscow.

oooo

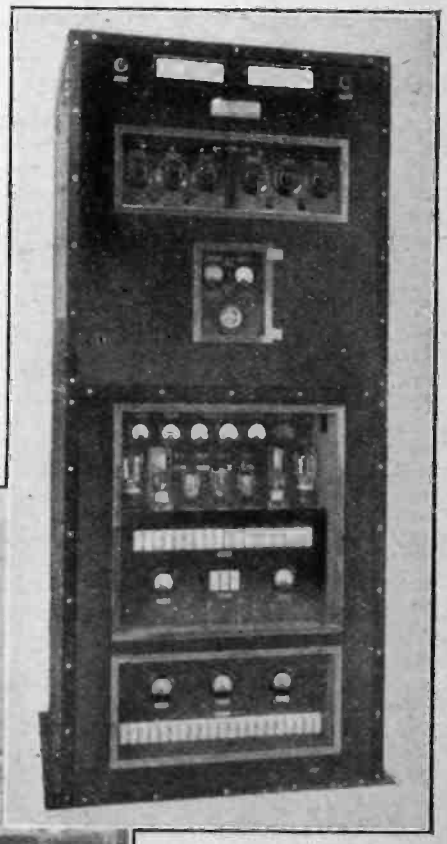
Russian Broadcasting.

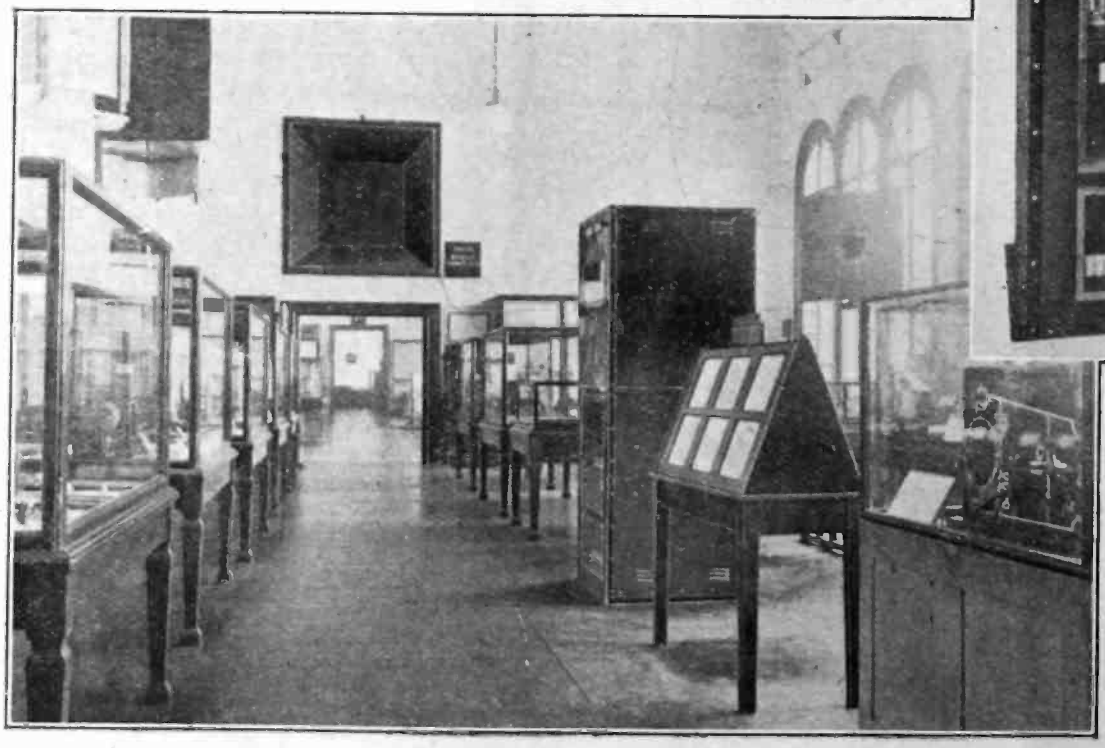
Mr. Lees-Smith said that as Russia was not invited to the International Radio Conference held in Washington some years ago she considered that she was not bound by the international regulations of wavelength, and she used certain wavelengths which were inconvenient to other nations. Russia did attend by invitation the last conference held at Prague, but while agreeing to come to a certain extent within the general international regulations she insisted on operating some of her previous wavelengths. It was through one of those wavelengths that on certain nights for weeks past she had been regularly transmitting messages to this country. It was now many months ago since he began to take some interest in those messages from Russia. For some time they were so exceedingly uninteresting, and therefore harmless, that the supervision was relaxed, but as the character of the messages had recently changed the supervision would now be resumed.

oooo

Stuttgart.

The Stuttgart station was observing the international regulations, but having lately greatly increased its power it could frequently be heard behind the London National programme. The matter could only be settled by negotiations, which were proceeding.





THE LAST WORD? Perfect reproduction of local programmes was the ideal sought after by the designers of the new demonstration receiver installed in the Science Museum, South Kensington, and fully described in our issues of July 30th and August 6th last. The upper photograph gives a near view of the receiver with the duplicated valves providing the two separate H.F. stages for the National and Regional transmissions. In the larger photograph can be seen the 27ft. exponential horn, the flare of which measures 7ft. sq.

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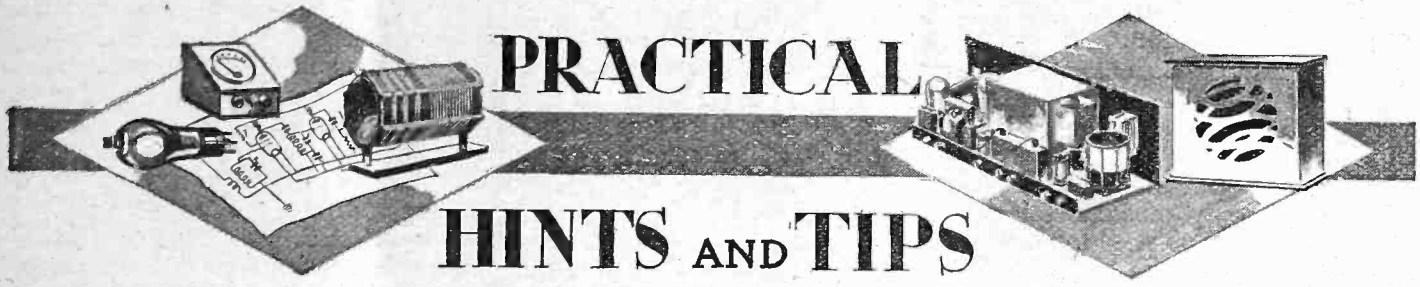

PRACTICAL HINTS AND TIPS

Simplified Aids to Better Reception.

"MUSIC MAGNET FOUR" GRAMOPHONE ADAPTION.

A number of those who have assembled the Osram Music Magnet Four "kit" set will doubtless be interested in the question of adapting this receiver so that it may be operated with a gramophone pick-up. Theoretically, at any rate, there is no difficulty in making the necessary circuit alterations, and the simplest way of doing so is shown in Fig. 1.

But in actual practice the problem is not quite free of pitfalls. It must be remembered that we are dealing with a highly specialised form of receiver, with ganged tuning control,

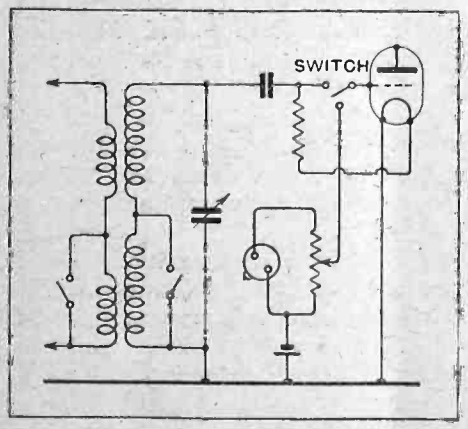

Fig. 1.—How to connect a pick-up (with volume control potentiometer) in the detector grid circuit of the "Music Magnet Four."

and that the indiscriminate addition of stray capacities at a danger point—the high-potential end of the detector grid circuit—is likely to have an adverse effect on its normal function of radio reception; apart from the danger of affecting the tuning system, there is a possibility that stability may be destroyed by the introduction of incidental couplings between circuits.

If any form of "switch-over" change be adopted the greatest care should be taken to reduce stray capacities to a minimum; the switch itself should have as little solid material as possible in its construction, and a component with insulation of ebonite or some other substance of similar dielectric properties should be chosen.

It will be remembered that the detector-grid condenser of the Music Magnet is mounted directly on the valve-grid terminal, and so must obviously be provided with some other form of support; it may be found convenient to secure it to the switch.

The important point is that incidental capacity across the detector grid should not be appreciably different from that allowed for by the designer. It might be possible to restore the balance by using a "skeleton" valve-holder; if this were done there would be less need to pay special attention to the switch or its mounting.

The view of the manufacturers, who have been consulted on this question, is that the average constructor is hardly likely to take these special precautions, and it is recommended that a plug-in adaptor should be used. In this way all technical difficulties consequent on the fitting of a switch are avoided, but the change-over from "radio" to "gramophone" is rather less convenient and takes more time.

A plug-in adaptor is a simple and inexpensive arrangement of suitably mounted pins and sockets, and is interposed between the detector valve-holder and the valve itself. Electrical connections (shown in Fig. 2) are normal with regard to plate and filament circuits, but the grid circuit is interrupted so that the pick-up, in series with a bias battery, may be inserted.

It will be obvious that, whatever method of conversion is adopted, it will be necessary, as an economy measure, to make provision for breaking the filament circuits of the H.F. valves. For the benefit of those who find difficulty in tracing theoretical circuit diagrams, it may be stated that the necessary switch should be inserted in the lead numbered 37 in the original wiring plan.

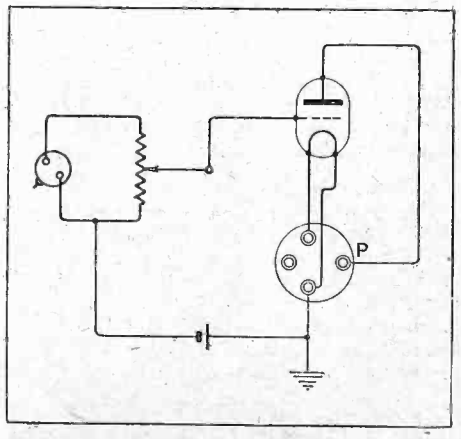

Fig. 2.—The result of interposing a gramophone pick-up adaptor between the valve and its holder: anode and filament connections are unchanged, but the grid circuit is interrupted.

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OUTPUT ANODE VOLTAGE.

It is not always realised that very high momentary voltages are liable to be developed on the anode of a super-power output valve—1,000 volts is by no means an impossible figure, even when the H.T. voltage applied does not exceed some 200 or so. To prevent the risk of a breakdown, and consequently of an H.T. short-circuit, it is wise to pay rather special attention to insulation in the output anode circuit, and, in particular, any by-pass condenser that may be joined between anode and earth should have a reasonably high factor of safety as regards its dielectric strength.

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D.C. MAINS AND POWER GRID DETECTION.

With hardly a dissentient voice the power grid detector has been accepted, by those best qualified to express an opinion, as the most practical and generally satisfactory rectifier of deeply modulated H.F. energy. There is no need to enlarge here on its advantages—or even on its disadvantages, beyond saying that this method of rectification would probably be even more generally used if it were more economical of anode current, had less tendency to introduce L.F. reaction, and, most important of all, could be made to operate on a lower anode voltage.

Access to an unlimited supply of volts enables us more or less summarily to dispose of the other difficulties. If we have a sufficiently high voltage it is unlikely that an extra three or four milliamps will make any appreciable difference to upkeep cost, and further, the existence of a surplus will allow us to be lavish with regard to decoupling, thus disposing largely of interaction troubles.

Some practical ways and means of overcoming these drawbacks when dealing with A.C. mains-operated receivers were discussed recently in *The Wireless World* under the heading of "Low Voltage Power Grid Detection." Most of the suggestions made there may be applied to sets drawing their anode current from D.C. mains, and, in particular, the push-pull output scheme described in that article is to be recommended, as none of the detector anode voltage need be dissipated in a decoupling resistance.

Those who are forced to content themselves with a less pretentious arrangement must generally be prepared to make some sacrifice in other directions; it is for the reader himself to judge whether the advantages of a sensitive and practically distortionless detector are sufficient to compensate for some loss in L.F. amplification, both with regard to its quantity and quality. Quantity does not matter greatly, as it is almost always easy to get sufficient magnification fully to load the average output valve; with regard to quality, losses are likely to take the form of a slight falling off in proportional amplification of the lower frequencies. It must be remembered that comparatively simple decoupling arrangements are capable of preventing instability when overall magnification is small, especially when the very low frequencies are not passed on at full strength.

As an L.F. coupling in such cases it is probable that a choke will be found most generally satisfactory, as it does not absorb nearly as much voltage as a resistance, and, while providing adequate magnification, does not give, like a transformer, what may be, in the circumstances, an embarrassingly high stage gain.

The detector valve itself is rather a problem in a D.C. receiver. Few of us feel inclined to supply an ampere of direct current for heating the type of A.C. valve that is customarily used, but fortunately it is possible to employ many of the ordinary "L" or "D" battery valves, with impedances in the order of 10,000 ohms or so. Under usual "power grid" operating conditions these valves may be slightly overrun, with a consequent reduction in their working life, but with care this matter need not be serious, and several of the manufacturers have given official blessing to the use of their products in this way.

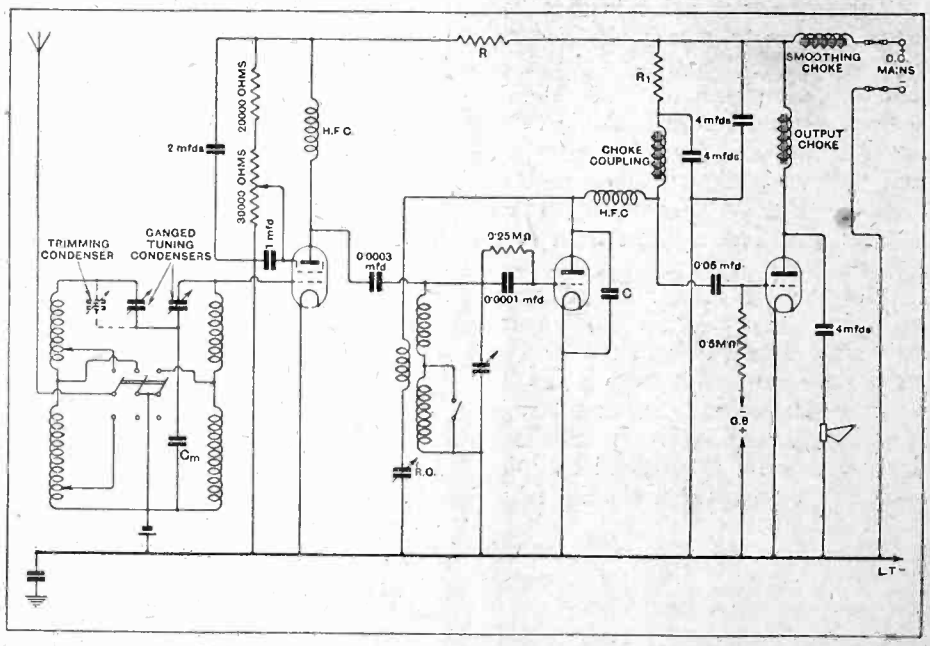

Fig. 3.—Power grid detection applied to a receiver deriving its anode current from D.C. mains.

Choke Coupling.

Hints as to how the foregoing suggestions can be put into practice may be gleaned from the accompanying diagram, Fig. 3, which shows the circuit of a 3-valve H.F.-det.-L.F. set embodying many of the features included in recent *Wireless World* receivers. A capacity-coupled input band-pass filter is included, and the H.F. stage is coupled by the "tuned-grid" system. Choke coupling is used between the power grid detector and the output stage. Values of most of the components are indicated, except where they are either obvious or dependent on comparatively unimportant features of the design. R is a voltage-absorbing resistance for the H.F. valve anode circuit, while R_1 is the detector decoupling resistance, which should have as high a value as possible consistent with the maintenance of a sufficiently high anode voltage—at least 100 volts, and preferably 120 volts. The by-pass condenser C should be made as large as possible without bringing about high-note loss.

An L.F. choke inductance of less than 80 henrys must be regarded as minimum unless a fairly considerable falling off in low-note reproduction can be tolerated.

Somewhat sketchy smoothing arrangements are indicated; if the mains supply happens to be "rough" extra smoothing will be needed.

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BROADCAST BREVITIES

By Our Special Correspondent.

Christmas Present for Scotland?—"Art Gallery" in Portland Place.—B.B.C. and Mühlacker.—A Pickwickian Hour.—Test Words.

Scotland in the News.

Scottish broadcasting is beginning to figure in the news once again. The opening of the new headquarters in Edinburgh has had a tonic effect on the public attitude to broadcasting north of the Tweed, and it would not surprise me if the B.B.C. were to continue the treatment with another dose before Christmas.

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A Christmas Announcement?

The new potion will take the form of an announcement that the Wester Glen site, on the Falkirk-Slamannan road, has been duly acquired for the erection of Scotland's Regional Station.

Some mystery has attached to the negotiations concerning this particular piece of land, due, I believe, to certain manifestations of native caution.

oooo

The Weather.

Now, subject to one or two formalities, the land is available for the preliminary spade work. If the B.B.C. are to justify their private slogan, viz., "a Regional station a year," the whole of the work ought to be completed in the early part of 1932. Possibly it will, but much may depend on the weather. As a frequent visitor, I always associate the Falkirk area with rain.

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"Music and Dancing."

"Broadcasting House" is reaching the "interesting" stage that characterises early childhood. I still await news concerning the filling of the niche over the entrance, but the suspense is partially mitigated by other items of information. A "music and dancing" licence for the giant studio has been applied for, though precisely why is not revealed.

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A B.B.C. Art Gallery.

Again, I hear that the pioneers of British broadcasting have been attending Savoy Hill in person to have their photographs taken. These are to be "hung" in a special vestibule at "Broadcasting House"—a miniature art gallery which modern exponents of the broadcasting art "seeing, may take heart again."

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Interference with London Regional.

At the time of writing, there is a distinct change for the better in regard to the interference caused to London Regional by the new German station at Mühlacker.

It is to the credit of the German authorities that they have taken immediate steps to limit the amount of overlap, by investigating the possibilities of readjusting the modulation system.

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Will Bergen Oblige?

The proposal has been made that Mühlacker should exchange wavelengths with Bergen, which is 9 kilocycles below the German station and therefore 18 kilocycles from London. The Germans have no objection, but the Norwegian authorities, not unnaturally, are a little doubtful as to what benefit they would derive from a change which would sandwich their station between London and Mühlacker.

A NEW MICROPHONE. In this condenser microphone now used at the Munich broadcasting station the "A" amplifier is incorporated in the instrument.

Mr. Pickwick to Broadcast.

A Dickens' dream fantasy, entitled "A Pickwick Party," will be broadcast on the National wavelengths on December 29. It has been written by Stanley C. West, with music by Marjorie Broughton.

Most of the well-known characters in Dickens' works will come to life, the scene being the Marquis of Granby Inn and the time Christmas Eve. Here will congregate Sam Weller (Kingsley Lark), Mr. Pickwick (Stanley Cooke), Mrs. Micawber (Gladys Palmer), Dora (Elsie Griffin), Jingle (Bernard Ansell), Mr. Wardle (Robert Chignell), Mr. Micawber (Joseph Farrington), Sairey Gamp (Lena Maitland), and many others. Howard Rose, the B.B.C.'s senior producer, will direct the "Pickwick Party" production.

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Tests for Gift Sets.

Last week reference was made to the special programme of gramophone records to be broadcast on Christmas Day from 12 noon to 3 p.m., to enable the lucky recipients of wireless sets to test them on every conceivable kind of music. It is now learnt that the transmission will be made from London Regional, not Midland Regional, as stated.

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A Christmas Day Appeal.

The Christmas Day appeal will be made again this year by Mr. Winston Churchill on behalf of the National Institute for the Blind. Mr. Churchill will speak at 7 p.m.

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"The Worth of Science."

From the nineteenth conference of Educational Associations, on December 31st, Sir Richard Gregory's presidential address on "The Worth of Science" will be relayed to London Regional.

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A Victorian Melodrama.

"The Silver King," one of the best-remembered of Victorian melodramas, one in which Wilson Barrett distinguished himself and one which brought its author, Henry Arthur Jones, a fortune, is to be broadcast in Christmas week, on the Regional wavelengths on December 26th and nationally on December 27th.

oooo

A Few Words.

One of the severest tests to which radio receiving apparatus can be submitted is being tried out during the school broadcasts on Wednesdays, Thursdays and Fridays. The test takes the form of a recital of a number of specially selected words, each having no connection with the others. The words are listened to by eight selected schools in London and by observers at the B.B.C., all using different receiving apparatus.

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Comparisons.

To identify every one of the words indicates the possession of an unusually good reproducer, and the results are already giving the authorities valuable information on the merits of the various instruments in use.

The test words have been selected in collaboration with the Telephone Research Department of the Post Office. Some of them are real "teasers."

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The H.S.P Screened Grid Four

Long Range Reception.

THE receiver which forms the subject of this review is a representative example of modern practice in portable receiver design. An examination of the figures provided by the Buyers' Guide in a recent issue reveals that the majority of portables are of the four-valve type with a single screen-grid H.F. stage. Further, slightly more than half the portables on the market at the present time are fitted in suitcase containers. Both these features are items of the specification of the H.S.P. Screened Grid Four.

The layout follows conventional practice, and the valves are sunk in a well in the control panel which runs along the front edge of the case. Behind this is the usual battery compartment with detachable cover. The lid of the case contains the frame aerial windings and a Celestion cone loud speaker chassis.

The frame aerial is wound in two sections, which are separated by a space of about 1 inch, and the turns of the low-wave winding are spaced. A switch in the left-hand bottom corner of the lid short-circuits the long-wave section of the winding. The same switch carries contacts for switching off simultaneously the H.T. and L.T. circuits. It is important to remember that this switch is essentially the "On-Off" control of the set and not the switch on the control panel, as is usually the case. The latter switch merely controls the H.F. anode and reaction coils, and does not carry any battery contacts. The fact that both L.T. and H.T. circuits are broken when the set is switched off prevents the possibility of damage should the L.T. leads accidentally fall onto the H.T. battery sockets while changing the accumulator.

Circuit Details.

The anode circuit of the screen-grid H.F. valve is decoupled, and the screen grid, for which a separate H.T. tapping is provided, is by-passed by a condenser of the non-inductive type. Tuned anode coupling is employed, separate inductances being provided for long and short waves. The coils are of small diameter, and each is wound in two sections in a slotted ebonite former. The reaction windings are interposed between the two halves of each anode coil.

Reaction, which is capacity controlled, is taken from the anode of the leaky-grid detector. Apparently no provision is made to prevent leakage of stray H.F. currents into the H.T. supply circuit and L.F. amplifier

Economical H.T. Consumption.

other than the inductance of the L.F. transformer. The provision of three by-pass condensers in the output stage would seem to indicate that H.F. does leak through the L.F. amplifier. But for these condensers, instability would result from the close proximity of the loud speaker leads with the frame aerial in the lid of the case. No doubt the makers have some very good reason for tying down H.F. in this rather special way, as it is usual to restrict H.F. currents to the detector anode circuit by means of a H.F. choke, by-pass condenser, and, in some cases, a series resistance in the grid circuit of the first L.F. amplifier.

Both L.F. valves are transformer coupled, the first transformer being a Mullard "Permacore," and the second an R.I. "Hypermu." The output valve, a Marconi P.2, working at about 99 volts H.T., feeds directly into the Celestion loud speaker unit. In addition to by-pass condensers in the grid and anode circuits of the output valve, the metal frame of the loud speaker is also tied down to H.T.+ by a small condenser fitted inside the lid.

High Frequency Response.

One would expect, with so many by-pass condensers in the last stage, to find a serious deficiency of high frequencies in the acoustic output from the loud speaker. In practice, however, this is far from being the case, and the quality is characterised by a clarity and crispness not often found in portable receivers. In particular, the reproduction of speech is natural and unforced. At full volume a slight buzz was noticed at certain frequencies, but this was probably located in the ornamental fret, and, in any case, the volume available before the buzz made itself manifest was more than adequate for normal requirements.

The set was tested in Central London, and again, under more severe conditions as regards selectivity, at a distance of five miles from Brookmans Park. In London a narrow band of two or three degrees between the two stations is left entirely free of background, but near Brookmans Park the fringe of one station just overlaps that of the other. Thus the foreign stations, recorded on short waves, were all received in the upper half of the tuning range. In all, eleven stations other than the B.B.C. stations were received on short waves, and of these six were at full programme strength. In daylight no difficulty was experienced in picking up

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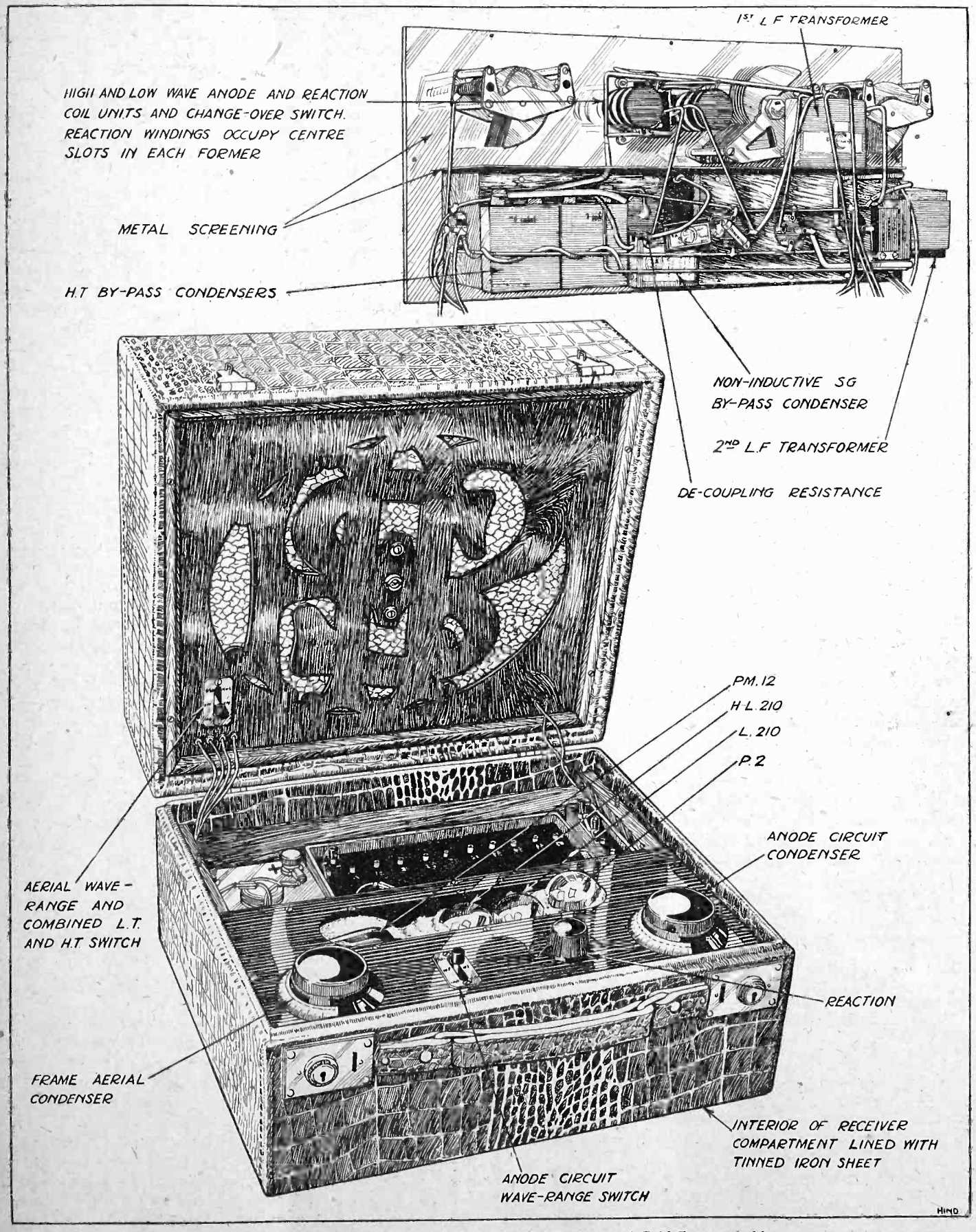

Chassis details and layout of controls in the H.S.P. Screened Grid Four portable.

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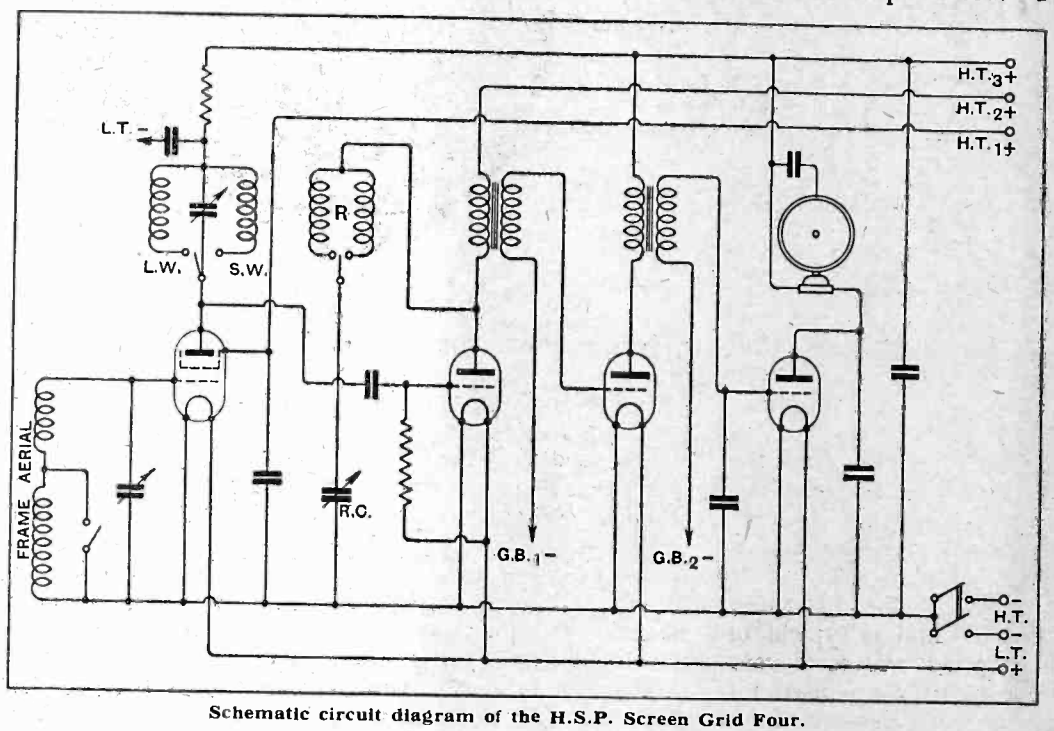
The H.S.P. Screened Grid Four.—

Langenberg, in spite of strong local electrical interference. Under normal conditions the background noise is extraordinarily small for a receiver of such sensitivity, and distant stations stand out in strong relief.

The long-wave performance maintains the standard set by the short-wave band. Nine stations—all at good programme strength—were received in addition to 5XX. Königswusterhausen, but Radio Paris and 5XX are easily separated in all circumstances. It is also gratifying to note that, even at five miles from Brookmans Park, the Regional Station did not break through at the bottom end of the long-wave scale, as sometimes happens. The reaction control, however, was somewhat erratic at this point, and as much as 90 degrees of backlash was experienced. Possibly this is due to the absence of H.F. stopping devices in the detector stage, as already noted.



Schematic circuit diagram of the H.S.P. Screen Grid Four.

Of these Radio Paris, Eiffel Tower, Motala, Moscow, Kalundberg and Oslo were exceptionally good. Königswusterhausen also came in well between Daventry and Radio Paris. It is necessary to make use of the directional properties of the frame when receiving

The set is economical to run, and the total anode current of the particular receiver tested was 7·3 milliamps. The H.T. battery was new, and no tendency to L.F. oscillation was evident under working conditions, but instability would be provoked by inserting a resistance of 60 ohms in the common −H.T. lead. As the increase of internal resistance of the battery may exceed this figure, more extensive decoupling might have been employed with advantage.

Judged from the point of view of performance, however, we have nothing but praise for this set, particularly in relation to its range and sensitivity, silent background, clarity of reproduction, and economy.

The makers are The H.S.P. Wireless Company, Langford Works, Weston-super-Mare, and the price of this particular model is 19 guineas.

PRINCIPAL TIME SIGNALS OF THE WORLD.

Particulars of signals from other important stations are included from time to time. Rugby, GBR, and Nauen, DFY (Germany) were included in our issue of Sept. 17, 1930

PARIS—EIFFEL TOWER, FLE.

Wavelengths: 113 kilocycles (2650 metres) and 9231 kilocycles (32.50 metres).

Times of Transmission: 07.55-08.06 and 19.55-20.06 G.M.T., on the long wavelength and at 09.25-09.30 and 22.25-22.36 G.M.T. on the short wavelength.

Preliminary Signals. Attention call CT −·−·− followed by B.I.H. −··· ·· ···· (Bureau International de l'Heure) and groups of − − − with one 5-second dash ending at the 30th second of the minute preceding the

International Time Signal from the Paris Observatory. Followed by **Rhythmic Signals** (see Rugby, GBR, p. 292, Sept. 17th, 1930).

Bordeaux, Croix d'Hins, FYL, and Issy-les-Moulineaux, FLJ, on 15.87 kc. (18900 m.) and 9231 kc. (32.5 m.) also transmit these signals at 07.55-08.06 and 19.55-20.06 G.M.T.

LENINGRAD DYETSKOE SELO, RNO.

Wavelength: 86.33 kilocycles (3475 metres).

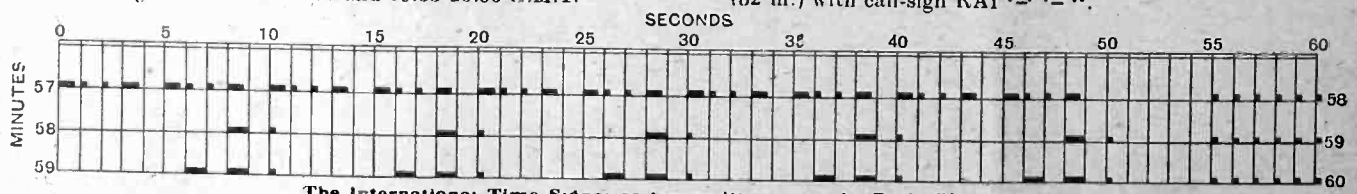
Times of Transmission: 21.55-22.06 G.M.T.

Preliminary Signal: Call-sign RET ·−· · −

Russian Ordinary Time Signals (from Central Russian Astronomical Observatory).

A series of single dashes terminating with six dot-seconds.
A series of double dashes terminating with six dot-seconds.
A series of triple dashes terminating with six dot-seconds.

The last of the six dots coming at 21.58, 21.59 and 22.00 respectively. Followed at 22.01 G.M.T. by **Rhythmic Signals** (see Rugby, GBR). Also at 15.55-16.06 G.M.T. from **Moscow Oktyabrskaya, RAI,** similar signals on 5769 kc. (52 m.) with call-sign RAI ·− ·− ··.



The International Time Signal as transmitted from the Paris Observatory.

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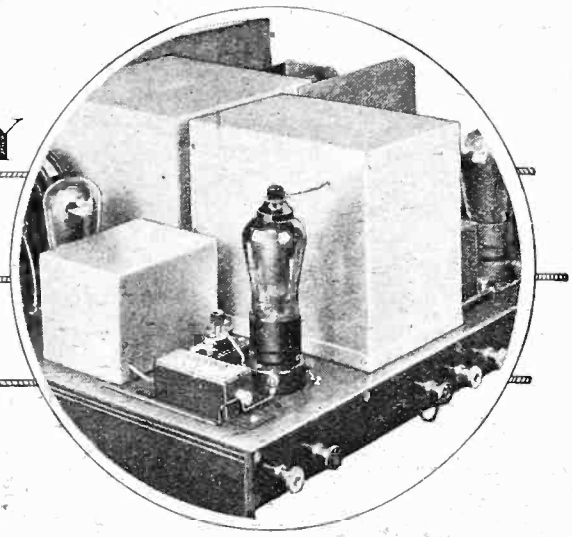
The Intermediate Frequency Amplifier of the Superheterodyne



The Causes and Prevention of Distortion.

By A. L. M. SOWERBY, M.Sc.

THE advances made in amplification at radio-frequencies, and the new valves that have been made available since the time when the superheterodyne was a popular receiver, will be manifest in all parts of a modern superheterodyne, but it is in the intermediate-frequency amplifier that the greatest improvements can be made. This point can, perhaps, best be seen by a glance at an intermediate-frequency amplifier designed about half a dozen years ago.

The circuit shown in Fig. 1 is that of the "Haynes-Griffin Simplified Superheterodyne," and is typical of the designs of its time. Ordinary triode valves of very low efficiency ($\mu=8$, $R_0=12{,}000$ ohms) were used for all purposes, and as a consequence three stages of intermediate-frequency amplification were required. The gain was probably about 20 per stage, neglecting reaction. Since the frequency-changer contributed practically nothing to amplification, the overall gain would thus be about 8,000 or 10,000 times from frame aerial to the grid of the second detector. This would be inadequate even in these days of high-power transmitters, and was doubly so six years ago; reaction, therefore, had to be used to increase the signal strength. In the receiver shown this was achieved by designing the amplifier in such a way that it was inherently unstable (due to feed-back through the anode-grid capacity of the valves used) and then controlling the tendency to oscillate by applying positive grid-bias to the valves by means of the potentiometer shown. By careful adjustment of this potentiometer the intermediate-frequency amplifier was balanced precariously on the verge of oscillation, in which condition the receiver as a whole became very sensitive and performed prodigies of long-range reception on a frame aerial.

Now it is an easily demonstrable fact that the longer the wavelength to which a set is tuned, the more marked is the deterioration in quality brought about by the use of reaction. It will therefore be understood that though distant stations could readily be received when the intermediate amplifier, tuned to 3,000 metres or more, was nearly oscillating, the loss of sidebands was far greater than would be tolerated at the present time. It is largely this reliance upon reaction, in place of pure amplification, that has earned the supersonic heterodyne

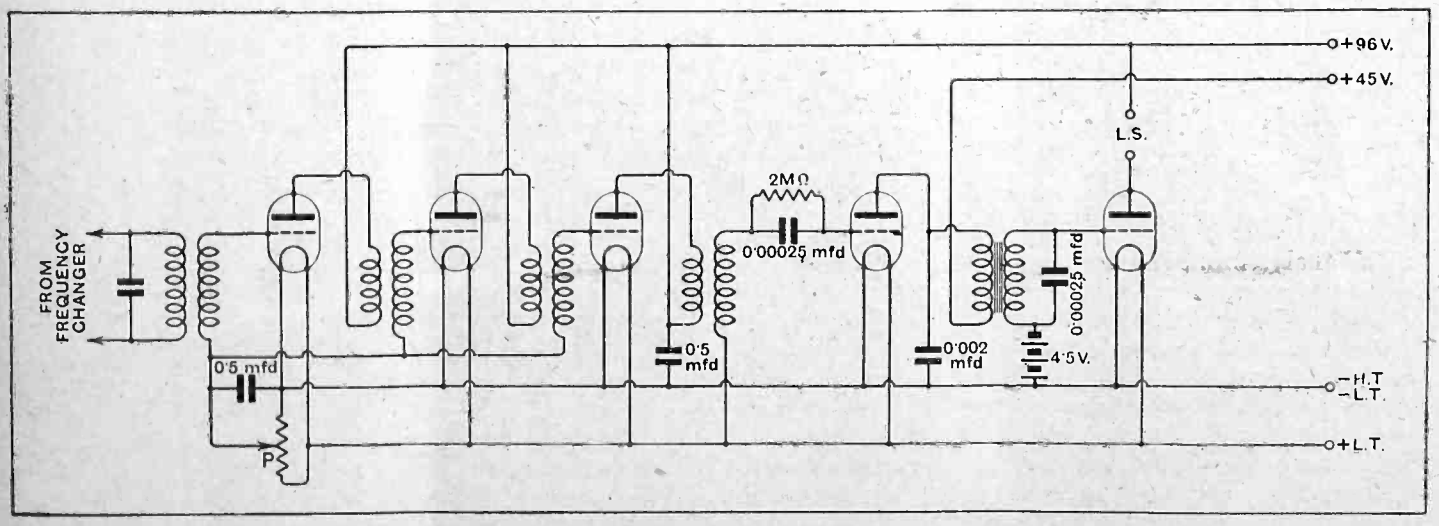


Fig. 1.—Circuit diagram of 1924 superheterodyne, omitting frequency-changer. Note: (1) Potentiometer P for putting *positive* bias on grids of amplifying valves. (2) Complete absence of all decoupling or stabilising devices of modern type. (3) The enormous capacities across primary and secondary of the L.F. transformer. (4) That the valves used had an amplification factor of 8 and an A.C. resistance of 12,000 ohms.

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The Intermediate Frequency Amplifier of the Superheterodyne.—receiver its very unenviable reputation for delivering signals of bad quality. This fault, however, is a matter of design only, and is not in any way bound up with the principles of the circuit.

The resonance curves of the intermediate-frequency transformers made for the set of Fig. 1 have been roughly

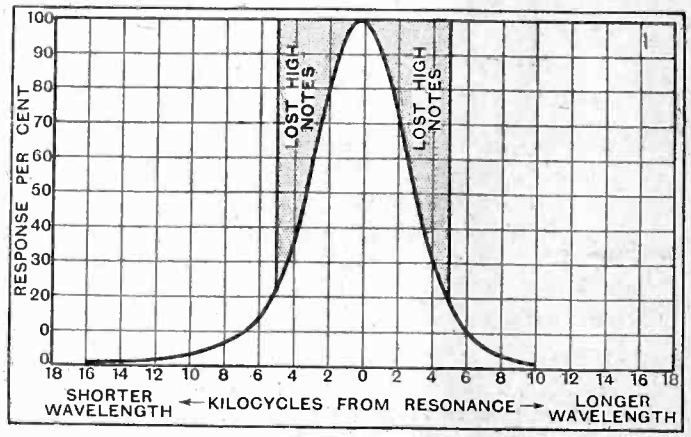

Fig. 2.—Overall resonance curve of the intermediate frequency amplifier of Fig. 1, on the assumption that no reaction effects of any kind are permitted to occur.

measured; neglecting reaction, the overall resonance curve of the intermediate-frequency amplifier is shown in Fig. 2. The loss of sidebands, brought about in the tuned circuits, even when reaction is not used, is seen to be quite appreciable, while with the amplifier nearly oscillating for the reception of a distant station the high notes would be almost entirely lost.

At the time when the receiver was designed the lower notes also were generally left to look after themselves. As a sample of the standard of quality that was then considered really good, a curve showing the amplification afforded at different frequencies by a first-class transformer-coupled L.F. stage is shown in Fig. 3. Details of the source from which the curve was taken are given below the diagram. If this curve is combined with the tuning-curve of the long-wave transformers, the overall performance curve that results is that shown in full line in Fig. 4. With extra high-note loss due to reaction this would be replaced by some such curve as that shown dotted on the same diagram. It will be appreciated from this that the old superheterodyne receivers very well deserved their reputation for poor quality of reproduction.

Dynamic Resistance on Long Waves.

The analysis that has been made of the causes of this bad quality gives us a very clear guide to design, for we see that we have to arrange that the tuning is flat enough to preserve the high notes and the L.F. transformers good enough to reproduce the low. The latter point is met, simply enough, by choosing a good modern transformer and using it in conjunction with a suitable valve; the conditions to be fulfilled are exactly those arising in any ordinary set. The question of the proper design of the tuning circuits, however, is a little more difficult—if only because few of us are accustomed to handling wavelengths of the order of 3,000 to 10,000 metres, and so have not the solid foundation of practical experience that helps to smooth out perplexities when dealing with the broadcast wavelengths.

The main difference, apart from the high inductance required, between long-wave tuning coils and those for the broadcast band is that even the most inefficient long-wave coil we can make has a very high dynamic resistance indeed, so that we are at once offered the possibility of very high stage-gain when using modern screen-grid valves. We are only limited in our ambitions by the danger of finding that the tuning has become too sharp for quality, even if reaction, accidental or deliberate, can be entirely avoided.

When Quality begins to Suffer.

If, for example, we stipulate that an amplifier built for a frequency of 50 kc., and including three tuned circuits (two stages of amplification), shall cut down 5,000-cycle notes by not more than 30 per cent., then if we use tuning coils of 50,000 microhenrys and tuning condensers of 0.0002 mfd., each coil must have a high-frequency resistance of 5,750 ohms in addition to the damping imposed by the preceding screen-grid valve. The dynamic resistance of the tuned circuit would then amount to no more than 43,000 ohms, while the stage-gain, using a battery-heated screen-grid valve, would not exceed 45 times.

It would be very easy to construct a coil of inductance 50,000 microhenrys with a high-frequency resistance not exceeding 250 ohms at 50 kc., thus giving a dynamic resistance over twenty times the maximum permitted by the requirements of quality, and yielding an amplification of over 350 times in a single stage. With possibilities of this sort dangled invitingly before our eyes, it would be absurd to put up with the meagre 45 times

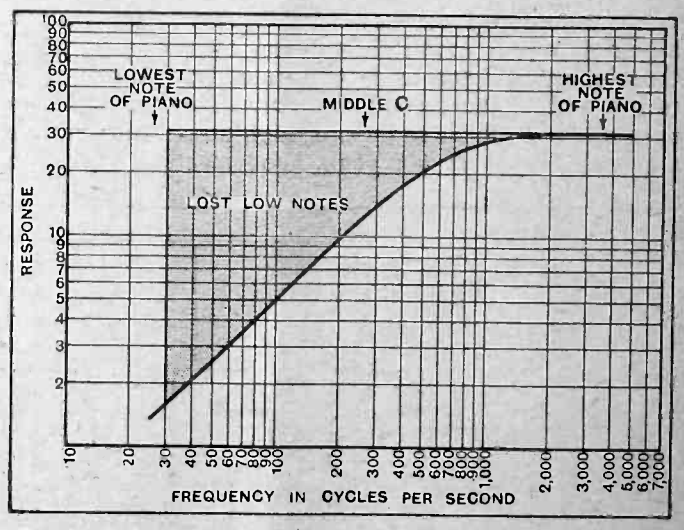

Fig. 3.—A first-class L.F. stage of six years ago. From N.P.L. curve of R.I. low-frequency transformer (1924 pattern), used with valve of that date. (*Experimental Wireless*, Vol. 1, p. 745, September, 1924.)

per stage that is the most that can be obtained from single tuned circuits before quality begins to suffer.

We abandon, therefore, the prospect of using several successive flatly tuned circuits, and turn our attention to the possibilities of the band-pass filter as an inter-stage coupling. If we work out the shape of the reson-

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The Intermediate Frequency Amplifier of the Superheterodyne.—ance curve to be expected from a filter built up from coils of resonably low resistance, we find that the filter has two very high and sharp peaks, even if the inductance of the coils is taken as high as is practically possible.

A curve of this kind is shown in Fig. 5, in which the response is seen to be more than five times greater for sidebands removed by 4 kc. from the carrier fre-

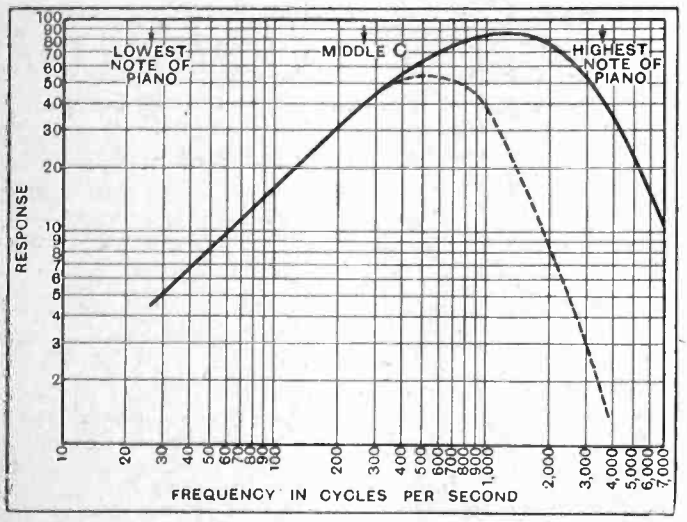

Fig. 4.—Composite curve of overall L.F. reproduction of 1924 superheterodyne, with no reaction, and only one transformer-coupled L.F. stage. In practice, the defects of the above curve were enormously exaggerated by reaction, as the dotted line suggests.

quency than it is for the carrier frequency itself. A wide flat-topped curve can be obtained only by raising the resistance of the individual coils of the filter to a very much higher value.

Where Band-pass is almost Essential.

It would appear, then, that the band-pass filter offers the possibility of no higher stage-gain than can be attained, for the same standard of quality, with simple tuned circuits. In a sense this is true, but the fact that the band-pass filter built up from low-resistance coils accentuates the sidebands almost as much as the simple tuned circuit accentuates the carrier frequency suggests that a combination of the two would be very profitable. A band-pass filter might well be used between the frequency-changer and the intermediate-frequency amplifier, the latter using single-tuned circuits throughout. The amplifier would then be designed for high stage-gain, without much regard for quality, and the filter that precedes it would be so calculated that sidebands were accentuated in the filter to the same extent that they are lost in the amplifier. The resulting overall curve, while not quite perfect, would be such as to give reproduction of very satisfactory quality, and would probably be distinctly better than the tuning curves of the average set. Fig. 6 gives the overall tuning curve of an amplifier which reduces 4 kc. sidebands to $\frac{1}{5}$th of the fundamental frequency, used in conjunction with the filter of Fig. 5.

By a combination such as this it becomes possible to use long-wave tuning coils wound to give high amplification without sacrificing the quality of reproduction.

In passing, it may be worth while to remark that by "coils wound for high amplification" we do not mean single-layer solenoids wound with Litzendraht. The coils used in calculating the filter whose very peaky tuning-curve is given in Fig. 5 are slab coils, wound with very fine enamel-covered wire; for all their high inductance they are only equal in diameter to a halfpenny, and are, perhaps, twice as thick. Regarded as tuning coils, they are about as inefficient as they could possibly be, but the shape of their resonance curve is such that they fall, all the same, into the category of "ultra-low-loss coils."

Since dielectric losses become negligible at the low frequencies with which we have to deal in the intermediate-frequency amplifier, the high values of dynamic resistance derived from a consideration of the copper losses of the tuning coils may safely be used as a basis of design. Apart from valve damping due to grid-current or negative reaction effects one is safe in assum-

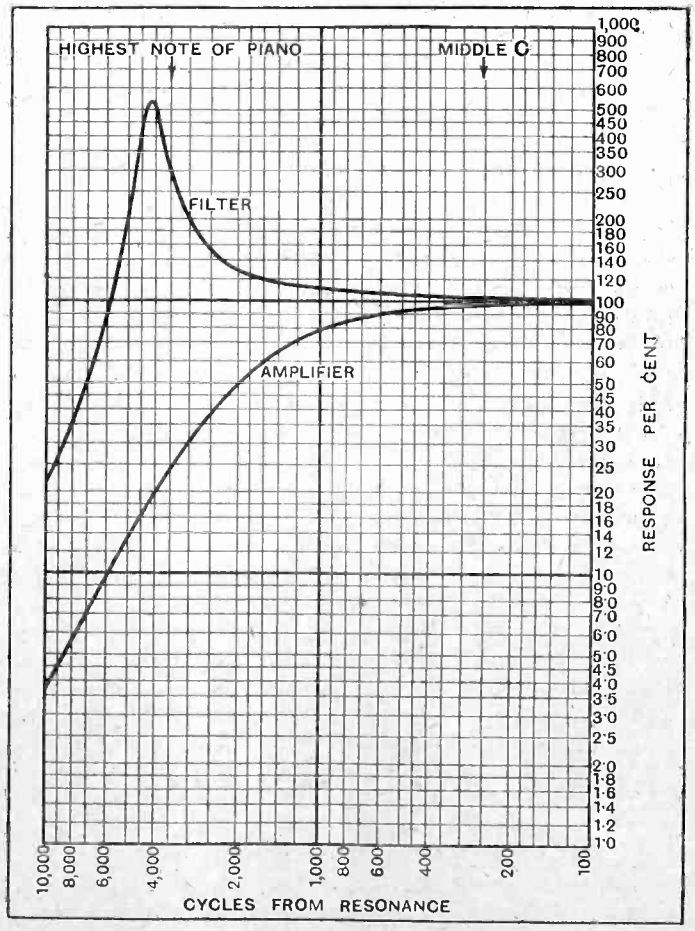

Fig. 5.—(1) Resonance curve of a band pass filter tuned to 40 k.c. Coils 150,000 microhenrys, resistance 700 ohms. Coupling, either 0.0005 microfarads common capacity, or 32,000 microhenrys common or mutual inductance. (2) Resonance curve of sharply tuned amplifier which, used alone, would give a very serious loss of high notes.

ing that the high-frequency resistance of the tuned circuit will not be more than double the direct-current resistance of the tuning coil—a simple rule that, while approximate, is very useful. Since a dynamic resistance of a megohm or more can easily be attained, one may hope for a stage-gain not far short of 400 times from

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The Intermediate Frequency Amplifier of the Superheterodyne.—the best of the battery-heated screen-grid valves, while theory indicates that even with so high an amplification perfect stability is very easy to attain.[1]

Practical experience, however, shows that two tuned-anode stages designed to give an amplification of this order oscillate continuously and mercilessly, though if step-up transformers of ratio about 3 to 1 are substituted for the tuned-anode connections no difficulties whatever are found. The writer does not wish to dogmatise on the reasons for this unexpected state of affairs, but is inclined to attribute it to the difficulty of finding a condenser of capacity large enough, and resistance low enough, to "earth" the screening-grids of the valves as perfectly as is assumed in the simple theory used for the calculation. If, through imperfect earthing, any intermediate-frequency voltages are allowed to appear on the screening-grids, the effectiveness of the internal screening of the valve is at once lessened, which appears to explain, qualitatively at least, the divergence between theory and practice. From the purely constructional point of view the effect is not very serious as long as one is forewarned, for even with step-up transformers of ratio high enough to ensure stability an overall gain approach-100,000 times can be attained with two stages without trouble from self-oscillation.

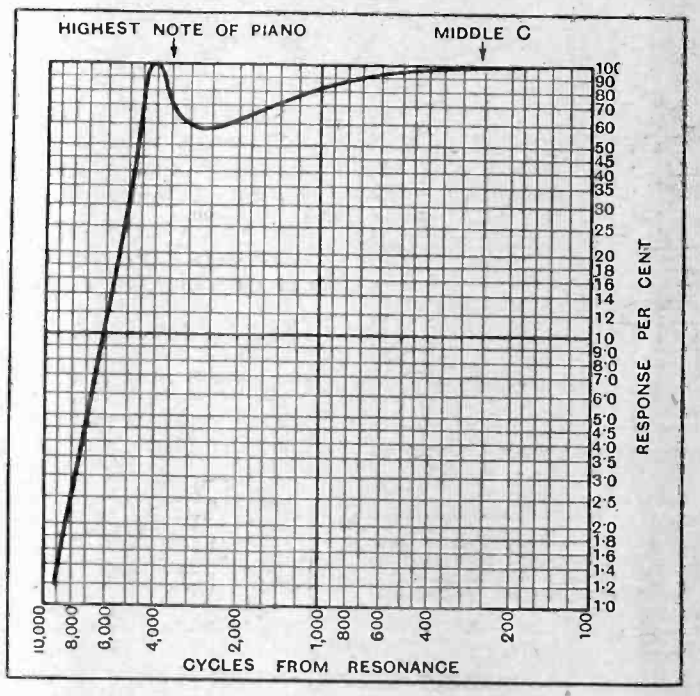

Fig. 6.—Overall response curve of the filter and amplifier whose curves are shown separately in Fig. 5. The response within the audio range (to 5,000 cycles) is reasonably even, while the extremely rapid falling off outside this region indicates very high selectivity. This type of curve is not difficult to realise in a practical amplifier.

The writer has actually had in operation a superheterodyne receiver in which, at a conservative estimate, there was an amplification in excess of one million times from frame aerial to grid of second detector. As might be expected, no aerial was too small, and no station too distant for such a receiver; the signals from Langenberg, in daylight, heavily overloaded the second detector when using a small tuning coil as frame aerial, even with stray pick-up almost entirely eliminated. On paper, this sounds the ideal receiver, but in practice it proved utterly useless owing to the one defect that is inherent in the basic principle of the superheterodyne.

Everyone who has handled a receiver which contains no high-frequency stage has, at some time or another, permitted the detector valve to oscillate, and will probably have observed that as long as oscillation continues a distinct "hiss" is heard in telephones or loud speaker. In an ordinary receiver, with which reception is possible only when the set is not oscillating, this hiss is, of course, quite harmless. In a superheterodyne, on the other hand, the continuous oscillation of a valve in the frequency-changer is an essential feature of the set, so that the "hiss" is being produced all the time. Where but moderate amplification follows the frequency-changer this hiss is not serious, and will probably pass completely unnoticed; in the experimental receiver just mentioned there was sufficient amplification to exalt the faint hiss into a continuous rushing sound that almost completely drowned the signals being received when anything like full amplification was employed.

Since the hiss given by the frequency-changer is approximately a constant quantity, not depending greatly on the strength of the signals being received, it is apparent that it will be necessary to limit the intermediate frequency amplification to an amount insufficient to bring the hiss up to noticeable strength. The writer's recent experiments have brought him to the conclusion that the fullest amplification that a single intermediate-frequency stage will yield leaves the hiss still at a low enough level to be quite harmless, while two such stages, even if made inefficient, are inclined to have too much background noise.

A receiver consisting of a frequency-changer followed by a single intermediate stage, second detector, and pentode, therefore, provides about the greatest usable amplification that can be attained from a superheterodyne; the amplification of such a set is high enough to receive Langenberg in daylight at audible loud speaker strength on a frame aerial 2ft. square. A receiver of this kind makes a very pleasing alternative to the usual three-valve set used with an open aerial, differing from such a set only in its immensely enhanced selectivity. If really reliable distance-getting properties are required, however, the amplification is hardly high enough, and, since the hiss of the oscillator precludes further amplification at the intermediate frequency, one can only add a further stage of ordinary high-frequency amplification before the frequency-changer. While adding an extra tuned circuit, making three tuning knobs in all, there is at least the compensating advantage that a small indoor aerial (consisting perhaps of a few feet of wire strung across the room or thrown on the floor) can be used in place of the more cumbersome frame without risk of annoying one's neighbours by radiation from the oscillator.

(To be concluded.)

[1] "The Stability of the Tuned-Grid Tuned-Plate Amplifier. Beatty, *Experimental Wireless*, January, 1928, p. 3.

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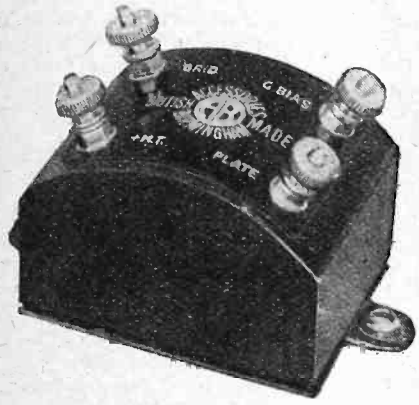
Laboratory Tests on New Apparatus

A.B. L.F. TRANSFORMER.

Made by Accessories (Birmingham), Weaman Street, Birmingham, this L.F. transformer is priced at 7s. 6d., the ratio being 3.5 to 1. A nickel-iron core is used, and the measured inductance at



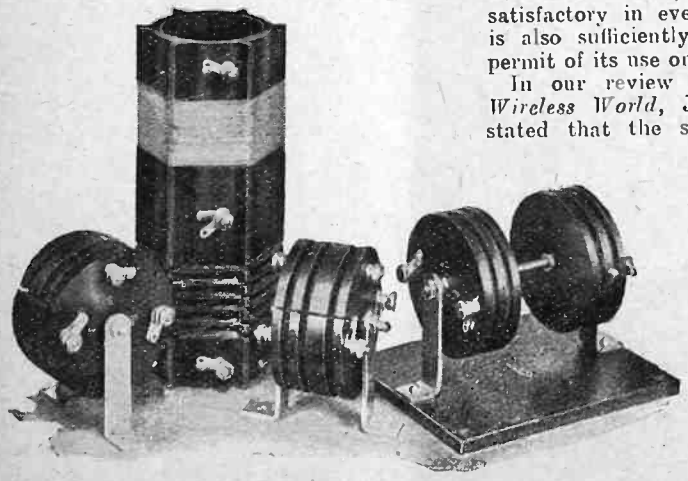
A.B. L.F. transformer made by Accessories (Birmingham). The ratio is 3.5 to 1.

50 cycles with no D.C. flowing was found to be 27.2 henrys. With 2 mA. of D.C. flowing, this falls to 18 henrys, and with 4 mA. to 13 henrys. Best results will be obtained with a preceding value of some 8,000 ohms impedance, and for preference using the resistance capacity method of coupling to deflect all D.C. from the transformer.

o o o o

COILS FOR BAND-PASS SUPERHETERODYNE.

A set of coils for the Band-Pass Superheterodyne receiver constructed to specification so far as the winding is concerned, but wound on ebonite bobbins in the case of the I.F. filter and oscillator coils, has been sent in by Wright and Weaire, Ltd., 740, High Rd., Tottenham, London, N.17. To facilitate connecting



Set of Wearite coils for the Band-Pass Superheterodyne receiver.

the various coils, the terminals and soldering tags are marked to correspond with the lettering on the constructional drawings in *The Wireless World* of November 12th last. The price of the complete set is 30s.

o o o o

MAGNUM DE-COUPLING RESISTANCES.

Made by Messrs. Burne-Jones and Co., Ltd., Magnum House, 296, Borough High St., S.E.1, these small wire-wound de-coupling resistances are available in two values, viz., 600 ohms and 1,000 ohms, the price in each case being 1s. 6d. The wire is wound in two grooves, the turns in one being wound in the opposite direction to those in the other, thus forming a non-inductive winding. A single wood screw serves to fix the component to the baseboard.

Magnum de-coupling resistance, available in 600- and 1,000-ohm sizes.

o o o o

BURNDEPT A.C. ALL-POWER UNIT.

In the Burndept Universal Screened-Five receiver the H.T., grid bias and L.T. for the A.C. valves are obtained from a separate unit, in which is included also the necessary smoothing equipment, the whole of this apparatus being housed in a metal container with a small external platform for the valve. This unit is now available for incorporating in home constructors' sets, and since it is a well-tried unit, should prove entirely satisfactory in every respect. The H.T. is also sufficiently free from ripple to permit of its use on the ultra-short waves.

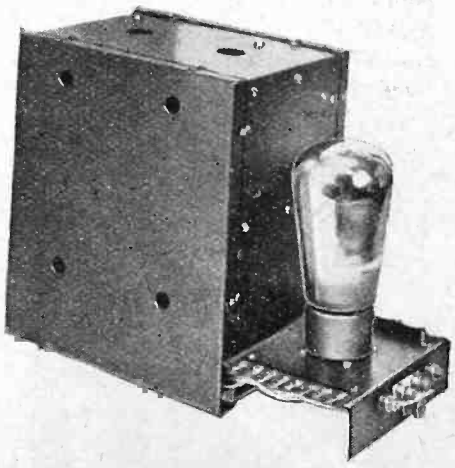
In our review of this receiver—*The Wireless World*, June 18, 1930—it was stated that the set functioned without hum down to 18 metres.

A sample unit was recently sent in for test, and we were thus able to obtain some measurements of the output voltages. A Phillips 506 full-wave rectifying valve was used. Two H.T. tappings are provided; one is intended for the power stage, and is rated to give 200 volts at 40 mA., while the intermediate tapping, the output from which is more completely smoothed, provides 180 volts, nominally at 5 mA. The output voltages are naturally interdependent, since they are derived from a common rectifier, so for purposes of test a fixed resistance was connected between the intermediate output tapping and the H.T.—and the output from the power tapping measured under various current loads, the voltage at the intermediate tap being noted at the same time. The results are tabulated below.

H.T. OUTPUT FROM BURNDEPT POWER UNIT.

Power Tapping.		Intermediate Tapping with Fixed Resistance in Circuit.	
Current.	Voltage.	Current.	Voltage.
10 mA.	295	8.5	270
20 ,,	270	7.8	244
30 ,,	245	7.0	215
40 ,,	220	6.4	195
50 ,,	192	6.0	178

Grid bias is derived from a separate winding on the transformer, a Westinghouse metal rectifier being employed. Thus the grid bias potentials are entirely independent of the H.T. and cannot cause undesirable coupling. Two G.B. voltages are provided, one fixed at 3 volts and the other adjustable to 30, 35 or 40 volts, according to the method of interconnecting four small terminals on the front of the valve platform. These voltages remain sensibly constant irrespective of the H.T. and L.T. load.



Burndept A.C. all-power unit for incorporating in receivers and supplying H.T., grid bias, and L.T. for A.C. valves.

An L.T. supply of 4 volts at 4 amps. is available for A.C. valves, this winding carrying also additional turns brought out to a separate terminal which allows 6 volts to be drawn at 0.5 amps. for the filament of a 6-volt directly heated output valve. When the full 4 amps. are taken from the heater winding the H.T. voltages are lowered by the small amount of 2 per cent.

The makers are Burndept Wireless (1928), Ltd., Aerial Works, Blackheath, London, S.E.3, and the price is £9, excluding valve.

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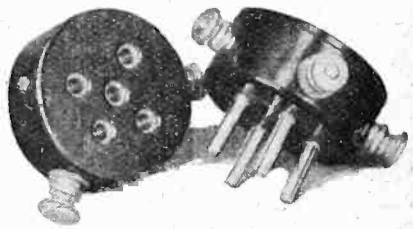
SIX-SIXTY GRAMOPHONE PICK-UP ATTACHMENT.

These adaptors are sensibly the same as the valve adaptors reviewed in these pages on June 25th last, the main difference being that additional terminals have been fitted to the two units. The centre pin on the 5-pin A.C. unit is brought out to a terminal, and a terminal has been provided affording a direct contact with the grid pin and socket.

The D.C. 4-pin unit has, also, a terminal contacting with the grid pin, thus enabling a gramophone pick-up to be employed without disturbing a single wire in the set.



Six-Sixty gramophone attachments for use in battery-operated and A.C. sets.

These units cost 2s. each, and the makers are Six-Sixty Radio, Ltd., 17-18, Rathbone Place, Oxford Street, London, W.1.

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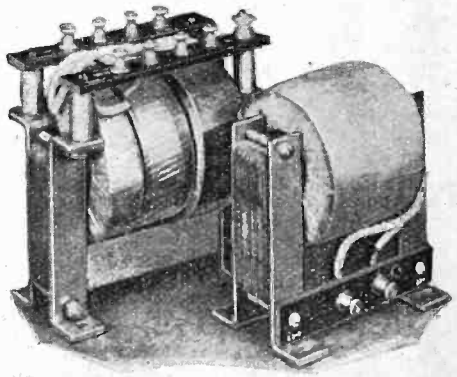
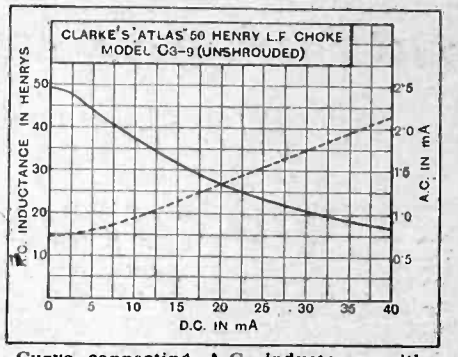
CLARKE'S "ATLAS" MAINS EQUIPMENT.

Messrs. H. Clarke and Co. (Manchester), Ltd., Atlas Works, Eastnor Street, Old Trafford, Manchester, have introduced recently a range of unshrouded L.F. chokes and mains transformers which are intended for use in sets where a shielded component is not essential. The particular samples tested comprise a 50-henry choke and a transformer rated to give 180+180 volts and 2+2 volts. Normally this would be used in conjunction with a valve rectifier of the 4-volt type, but under certain conditions a metal rectifier could be utilised, and the 4-volt winding employed to supply the heaters of A.C. valves.



Clarke's "Atlas" 50-henry L.F. choke and mains transformer type 1553F-7.

The inductance of the choke was measured at 50 cycles with various amounts of D.C. flowing, the results being plotted in the form of a curve connecting A.C. inductance with D.C. milli-

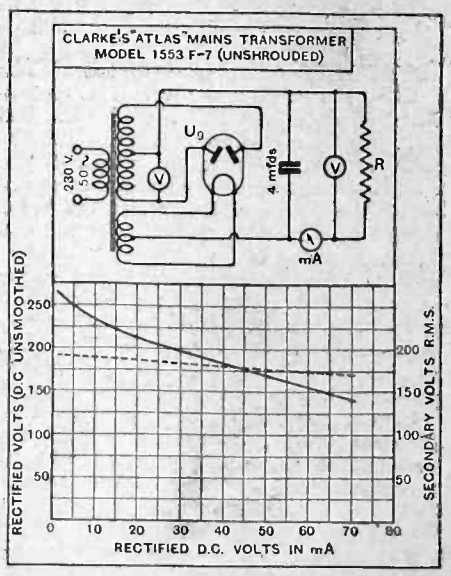


Curve connecting A.C. inductance with D.C. through the winding is given in the full-line curve and the superimposed A.C. in mA. in the broken-line curve—for Clarke's "Atlas" 50-henry L.F. choke.

amps. through the winding. This is the full-line curve on the graph. The broken-line curve shows the 50-cycle A.C. component in mA. flowing through the coil.

The D.C. resistance of the 50-henry choke was found to be 850 ohms, and the price is 30s.

For the purpose of test the mains transformer, model 1553 F-7, was used in conjunction with a Marconi U9 full-wave rectifying valve, since this operates on 4 volts, the test circuit being quite orthodox, and, as shown on the graph, a 4 mfd. reservoir condenser is used. Other makes of rectifiers can be utilised if desired, provided a 4-volt type is chosen; the Osram U9, Mullard DW2,



Output curves from Clarke's "Atlas" mains transformer, type 1553F-7, when used with a Marconi U9 full-wave rectifier.

and the Philips 506K, to mention a few only of the alternative types that are suitable.

The unsmoothed rectified output is shown by the full-line curve, while the broken-line curve shows the A.C. voltage (R.M.S. values) across one-half of the H.T. secondary winding during the time of test. The input voltage was 230 at 50 cycles. The primary winding is not tapped, but it is stated as being suitable for all mains voltage of from 200 to 250 volts, 40-120 cycles. The rectified output will be greater or less than that shown on the graph, according to the relationship between the available mains supply and that used for the purpose of our tests. The filament voltage for the rectifier will vary also.

The price of the model illustrated is 30s.

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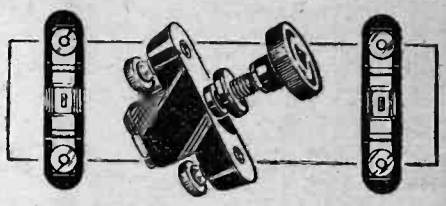
"BUSCO" BATTERY SWITCH.

The body of this switch consists of a bakelite moulding, the centre of which is hollow and forms a guide for the moving contact. This takes the form of an inverted "U," the two arms sliding into spring contacts when in the "on" position. The contacts are, therefore,



"Busco" battery switch with moulded base and self-cleaning contacts.

self-cleaning. A single-hole fixing bush is provided, and, although the spindle is "live," the switch can be fixed to metal panels, as the bush is provided with an insulating collar and washer.

The makers are Messrs. Busby and Co., Ltd., Price Street, Birmingham, and the price is 1s. 3d.

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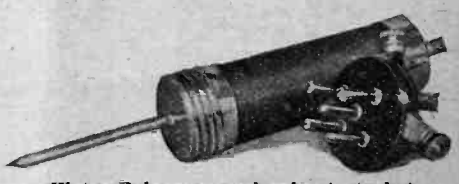
WATES POLYSCOPE AND VALVE TEST PLUG.

Used in conjunction with the Wates 3-in-1 meter, the Polyscope enables continuity tests and measurements of resistance to be made. It consists of an insulated container with metal end caps; one carries a long prod, and the other a split socket to take the contact point of the meter. The container is designed to accommodate an Ever Ready No. 8, or similar size, dry battery.

An instructional leaflet explains fully the method of use and gives a table showing the meter readings for resistances of from 14 ohms to 2,800 ohms. The price is 3s.

The valve test plug is of the 5-pin type with a similar number of sockets mounted above. All sockets, with the



Wates Polyscope and valve test plug.

exception of the anode connection, are joined to their corresponding pins. The anode socket and its pin are each brought out to two small terminals, thus enabling a milliammeter to be inserted in the circuit for the purpose of measuring the current. The price of this adaptor is 2s. 6d. The makers are the Standard Battery Co., 184, 188, Shaftesbury Avenue, London, W.C.2.

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Bon Marché Screened Grid Eight.

A Low-priced Radio-gramophone of Exceptional Range and Selectivity.

THE receiver-amplifier chassis which forms the nucleus of this instrument is of American origin, and follows the best modern practice. It is designed for A.C. mains operation throughout, and there are three screen-grid stages tuned by a triple gang condenser, with accessibly placed trimming condensers. No reaction is employed, and the detector is followed by two low-frequency stages, the first resistance-capacity coupled, and the second transformer-coupled to two power valves in push-pull. The output is matched to the moving-coil loud speaker, which has been designed specially for use in conjunction with this chassis. The output transformer is mounted in the loud speaker unit, and a five-way multiple cable is used to connect the two units. Three of the leads are for the push-pull output, and the remaining two supply the field winding, which serves also as a smoothing choke for the H.T. supply to the receiver.

There are four controls: a central tuning knob with illuminated drum dial, on the right a combined radio volume control and gramophone switch, on the left an "on-off" switch, and above the escutcheon plate a push-pull wave range switch. A small two-way switch on the chassis gives alternative mains input voltages.

The gramophone motor is of the induction type, and the pick-up is a B.T.H. Gramophone volume is controlled by a compression-type resistance in series with the pick-up, and a separate push-button switch is fitted to the left-hand side of the cabinet for starting the gramophone motor.

Bon Marché Screened Grid Eight radio-gramophone. The specification includes three screen-grid H.F. stages, push-pull output and a moving-coil loud speaker.

The whole equipment is housed in a cabinet of imposing appearance, the dimensions of which are: Height 2ft. 11½in., width 2ft. 2½in., depth 1ft. 9in. The back is left open to obviate box resonance.

The performance on the radio side is most impressive. Without any concentration or close adjustment of controls, twenty-five foreign stations were received on short waves and eight on long waves at full loud speaker strength. In the case of thirteen of these stations it was necessary to make use of the volume control in order to prevent overloading of the output stage. In spite of the high degree of sensitivity, however, the background noise is commendably low.

The set was tested on an outdoor aerial 50ft. in length with an average height of about 18ft. at a distance of only five miles from Brookmans Park. Nevertheless, five Continental stations were received between the two Brookmans Park transmitters, and ten degrees of the dial between these stations were absolutely clear of interference. The very complete screening of components contributes materially to this result. With the aerial detached, the volume control has to be turned up to maximum to get the local transmitters, but if a 2in. length of wire is connected to the aerial terminal, the control has to be turned almost to minimum to keep the volume within bounds.

The long-wave selectivity is satisfactory, but does not equal the standard set on short waves. Königswusterhausen can be received clear of Radio Paris, but is overlapped by Daventry. On the other hand, interference from the Brookmans Park transmitters is limited to a few degrees at the bottom of the long-wave range.

Quality of reproduction is of a high order, particularly on the radio side, but the high-note response in gramophone reproduction appeared by comparison to be slightly curtailed. Tests with standard frequency records, however, showed that the gramophone response is good up to 3,000 cycles. We understand that a potentiometer volume control will replace the series resistance in future models.

In the matter of price, the makers, Bon Marché, Ltd., Brixton, London, S.W.9, undoubtedly live up to their name; for the oak cabinet model costs only 39 guineas, while the mahogany and walnut models are priced at 42 guineas and 45 guineas respectively.

The cabinet work in the instrument illustrated is constructed with a solid frame, panelled with oak-faced, three-ply wood. In the models now in production, however, the woodwork, including the panels, has been considerably strengthened. A further improvement is that the gramophone motor switch is now mounted on the motor board instead of on the outside of the cabinet.

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Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

CIRCUIT DIAGRAMS AND SERVICE.

Sir,—I have read with much interest your Editorial comments *re* diagrams being supplied with sets as sent out by manufacturers. This is certainly a long-felt want, though in my opinion the full and correct solution to the problem of servicing is, to supply as an integral part of the set, by permanently affixing to the lid or other suitable part of the set, a pictorial diagram showing the listener how to connect the batteries, and a circuit diagram for use of the service man.

Another very essential feature is that the wiring should be carried out on a colour scheme, in order to simplify the identification of each section of the circuit.

It seems as though designers have been lacking in these respects, when we remember that much simpler electric apparatus is provided with these advantages. Take, for instance, the house telephone, which has diagrams permanently attached to prevent their loss or wrong diagrams being used. The colour scheme in this case is in the connecting wires.

If this system were adopted it would considerably lighten the troubles of the service man, who has quite enough to contend with and cannot be expected to remember all the circuits, and also would prevent the dabbler from soldering that loose wire on to the terminal to which it *looks* as though it belongs.

It would also help to solve some of the Chinese puzzles set for the repair man by the amateur *expert* who has tried to make a Meccano three out of a Super-Regenerative, and having failed, gives the set just as it is to a friend, who takes it to the wireless shop to get it put right, and who complains bitterly because he is charged a few shillings because the set had to be rewired.

I say, therefore, definitely, let us have diagrams and colour schemes which will benefit everybody concerned.

A. DE VILLIERS,
Hon. Organising Secretary,
The National Federation of Radio Retailers.

THE SUPERHETERODYNE.

Sir,—The writer has been much interested in Mr. Sowerby's articles on the superheterodyne, and must congratulate him on the design of a really remarkable set in the "Band-pass Superheterodyne."

Whilst this set would probably satisfy the requirements of the majority of listeners, the writer is of the opinion that the stenode radiostat principle offers still greater possibilities in the matter of selectivity with good quality.

It has been recently announced that a broadcast model of the stenode radiostat has been evolved which gives a very high degree of selectivity without the complications of the quartz-crystal gate. This new circuit, the writer assumes, utilises a sharply tuned I.F. amplifier, with an L.F. amplifier designed to compensate for the loss of high notes.

By using several low-loss circuits in the I.F. amplifier, the writer imagines that the response at 9 kc.s from resonance should be reduced to a very low value, completely eliminating even the immediately adjacent transmissions. Whether the side-bands of the local transmission would interfere with the reception of adjacent stations remains to be decided by a practical test, but, from a theoretical examination of the subject, the writer thinks that even this interference should be eliminated by a really sharply tuned I.F. amplifier.

There are disadvantages to this type of set, it is true, some of which may be mentioned. The chief one is the extra L.F. amplification required. Sufficient amplification would have to be provided following the detector to restore the high notes to their original relative strength. The L.F. gain required may easily be as much as 100,000, depending on the selectivity and high-note response desired.

Another disadvantage is the extremely critical tuning of the oscillator, and the probable variation of quality with slightly different settings of this control. Also, slight frequency modulation at the transmitter may be found to spoil reception completely.

On the other hand, it should be possible with a set of this type to separate stations differing in frequency by only 5 kc.s, whilst still retaining good reproduction of high notes. If one is content with 9 kc. separation, then better high-note reproduction should be possible than with the alternative band-pass method.

WM. J. HOLROYD.
Halifax.

MUHLACKER.

Sir,—The remarks on page 599 of your issue of November 20th were, of course, written before this station began to transmit on 70 kilowatts.

Since then the London Regional transmission has been practically blotted out in the South of England, and if double this power is really contemplated we can say good-bye to the excellent programmes which so many thousands of us have appreciated since the new Brookmans Park station came into being.

Doubtless some means will be found of altering the respective wavelengths of the two stations so that they may be separated by at least six metres, which appears to be the minimum within which an ordinary set can avoid interference.

To my mind—and I am sure it must occur to many others—the most distressing feature of this interference incident is the utter lack of foresight on the part of the B.B.C. engineers. They have had many months' notice of the intended transmission, and instead of dealing with the matter in advance they have apparently done nothing. I am a great admirer of the B.B.C. and its wonderful organisation; I appreciate all that it gives us; and, knowing something of Continental broadcasts, I can assert that we have the best all-round programmes in the world. Is it not regrettable, therefore, that they should spoil a good record by allowing such a blunder to be committed?

A. HOARE.
Hindhead.

SERVICE.

Sir,—With reference to the letter you publish in the issue of December 3rd under "Service," it may interest your readers to know that we have had quite a number of people in our shop who are entirely dissatisfied with the "service" they get for 6s. per annum. We have explained that real service *cannot* be given for 6s. per annum, and it strikes us that it is really another form of salesmanship, as in most cases the existing set has been condemned and a new one suggested.

We think it misleading to suggest that real and adequate service *can* be given for 6s. per annum. In one case we know of there is not a technical man on the board of directors, and the service charge is merely an introduction to the house with the object of selling a set of well-known manufacture from whom this firm are able to get factors' terms.

As we do not wish to advertise the real service we do give we sign ourselves,

"RADIO DEALERS."
West Ealing, W.13.

PITCH OF THE HUMAN WHISTLE.

Sir,—Messrs. Seymour Pile and Vernon Coombs are correct in thinking that the tone of 32 and 16ft. organ flue pipes is principally fundamental, "strings" excepted.

This is purposely so in order that a limited number of these stops—which are very expensive—shall form a passable bass for the varied tone colours of the manuals.

Because of the preponderance of fundamental, these low notes are seldom reproduced properly by loud speakers; but directly pedal reeds, which have a greater harmonic development, are drawn the pedal department becomes alive.

Probably the missing fundamental is suggested to the ear by the harmonics.

A trick of this kind is practised in the "Acoustic 32ft.," where 16ft. tone pipes suggest a 32ft. note, although there may be no 32ft. pipes in the organ.

Anyone with a wireless set which reproduces the whole range of organ notes from 32ft. upwards in proper proportion has something to be proud of!

WM. A. RICHARDSON.
Ashford, Kent.

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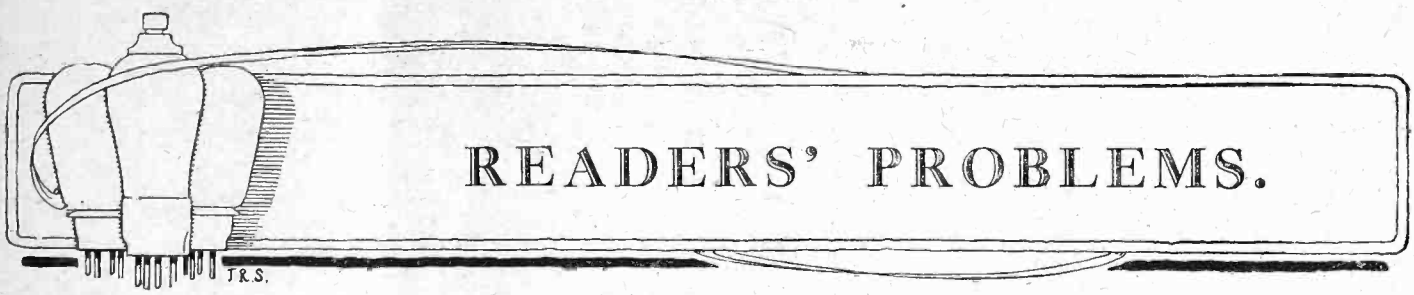

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

Why an Input Volume Control is Necessary.

It has been suggested on more than one occasion by contributors to your journal that an input volume control is desirable, if not actually necessary, when band-pass tuning is employed. But surely it would be unnecessary to add this refinement to an unpretentious det.-L.F. two-valve receiver? A set of this nature seldom gives excessively loud signals, and it would appear to be superfluous to make provision for reducing detector input. I should like to have your views on this matter. F. M. B.

We think it is a mistake to assume that a det.-L.F. set is unlikely to stand in need of an input volume control when it includes an input filter. It is well known that signal voltages of from 5 to 10 volts may easily be developed across the grid circuit of such a receiver at distances of a few miles from a powerful broadcasting station; H.F. voltages of this order are more than high enough to overload a grid detector of the type customarily employed. As a filter cannot operate properly unless its circuits are accurately tuned, it is clearly impossible to obtain satisfactory results unless some means either of regulating input from aerial to filter or from filter to detector are provided.

We do agree, however, that it would be wasteful to fit a control of this sort if the receiver is to be used under such conditions that detector overloading will be virtually impossible; in such cases a post-detector control—which is simpler and less expensive—is perfectly adequate.

o o o o

A Four-element Filter Circuit.

On page 519 of your issue dated November 5th there is published a circuit diagram of a double filter with four variable condensers: I should like to do some experimental work on these lines, and would be obliged if you would give me details of the various tuning coils and coupling inductances. It is intended to confine operations to the medium broadcast waveband only. P. C. P.

As implied in the article to which you refer, these cascade filters, intended to give constant frequency width over the tuning ranges normally covered, are still in the embryonic stage. We have not yet sufficient practical data to give a definite answer to your question, and fear that the subject cannot be treated adequately in a limited space. It is hoped that this matter will be treated exhaustively in the near future.

o o o o

Listening to Harmonics.

In the early days of broadcasting I was often able to hear the second harmonic (one-half the fundamental wavelength) of several transmitting stations, but now I notice that these harmonics are much more difficult to find and are much weaker. As there has been a general all-round increase in transmitting power, this seems rather surprising. Can you tell me what is the explanation? J. D. W.

The radiation of harmonics by a transmitting station has always been recognised as undesirable, and for some time past a good deal of work has been done in devising means whereby the generation of subsidiary frequencies—or, at any rate, the radiation of these frequencies from the aerial—may be minimised. Considerable advances have been made, and now very few stations are bad offenders in this respect.

L.T. Accumulator Charging.

Will you please show me how to charge my 2-volt L.T. accumulator from 220-volt D.C. mains? I believe that it is possible to do this without expense by joining the battery in series with the household lighting system, but am not quite clear as to where connection should actually be made.

I am sending you a rough sketch of my main switchboard, and should be obliged if you would indicate the correct connections. A. B. T.

An accumulator can be charged in the way you suggest; the only disadvantage is that the mains voltage will be reduced to an extent equivalent to the back-

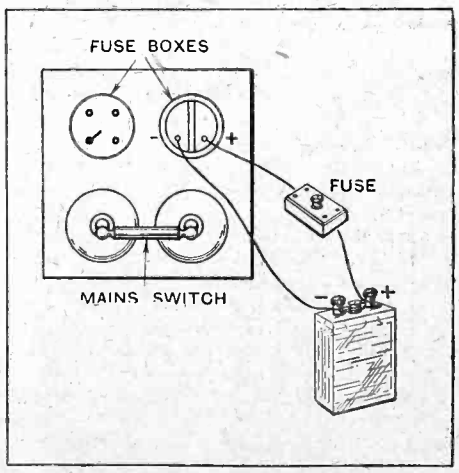

Fig. 1.—Charging an accumulator cell from D.C. lighting mains.

E.M.F. of the battery. In your case this will be quite negligible, and there will be no apparent diminution in the brilliancy of the lamps.

The most convenient way of joining the accumulator to your switchboard is shown in Fig. 1. One of the fuses (preferably that connected in the earthed main lead) should be removed, and the accumulator should be connected to the fuse terminals.

It should be pointed out that the cell may be damaged if your consumption of current for lighting purposes exceeds its maximum safe charging rate. By counting up the number of lamps likely to be in use at any one time, and allowing roughly ¼ amp. for each 60-watt lamp and ⅛ amp. for each 30-watt lamp, you will be able to estimate whether this charging rate is likely to be excessive.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

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Power Transformer Modification.

With reference to the power transformer described in your issue of January 22nd, 1930, will you please tell me how to modify the filament winding for a rectifier valve taking 2 amps. at 4 volts? D. R.

A suitable winding would consist of 24 turns of No. 18 double cotton covered wire, 12 turns being wound on each bobbin.

o o o o

Converting an Old Receiver.

I have a somewhat out-of-date four-valve set with two H.F. stages coupled by the tuned-grid method, and a grid detector. This has never been really satisfactory, and I am inclined to build a new set for long-distance work, modifying the existing receiver for local station reception (my nearest transmitter is about forty-five miles away).

The old set has ganged tuning control, and, if possible, I should like to eliminate one of the H.F. valves and to make the first two tuned circuits act as a filter. Do you think that this could be done without much trouble? A. T. R.

It so happens that your set should lend itself quite readily to alterations on the lines suggested. Although you do not send a diagram, we expect that its circuit arrangement is very much on the lines shown in Fig. 2. If this is so, the first two circuits can be made to form the elements of a filter merely by removing the input H.F. valve, and, after breaking the second grid lead at the point marked X, inserting a variable coupling condenser between the high-potential ends of the two circuits. This condenser should be very small, with a maximum capacity of not much greater than fifteen micro-microfarads, and it should be possible to find an adjustment for it that will give proper filter tuning.

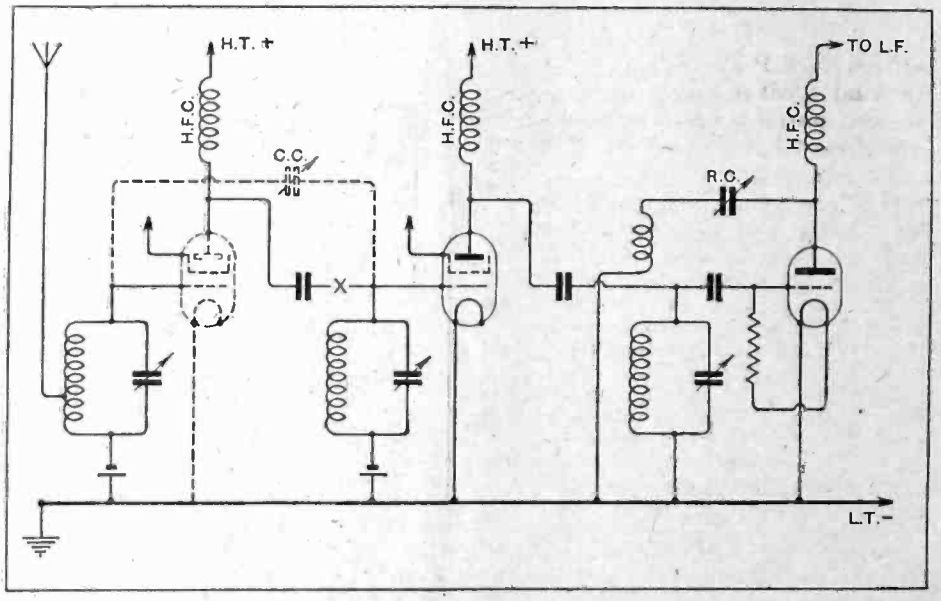

Fig. 2.—An easy conversion: a "2-H.F." set modified for band-pass tuning by eliminating the first high-frequency valve, and adding a coupling condenser, of which the connections are shown in dotted lines.

You must not lose sight of the fact that by removing the valve and by isolating the second tuned grid coupling the stray capacity values across these circuits will be changed appreciably, and it will be necessary to readjust the ganged condensers.

o o o o

Cost of Filament Current.

I have just completed an H.T. eliminator for feeding my three-valve set from the D.C. supply mains. Results are entirely satisfactory, and I am now thinking of attacking the L.T. problem. It has been stated that it is extravagant to feed valves connected in the ordinary way (i.e., in parallel) from the mains, but it would appear very much easier to do so than to join all filaments in series as is generally recommended. Will you tell me for what length of time a single unit of electricity should be capable of supplying filament current? The valves consume a total of 0.55 amp., and the main supply is at 240 volts. T. C. E.

The filaments of your valves will consume $240 \times 0.55 = 132$ watts. This means that one unit of electricity (1,000 watt-hours) will feed the circuit for slightly over 7½ hours.

If your current is supplied at a low rate it is quite possible that the cost of running the set in this way will be low, in spite of the fact that the greater part of the energy used will be dissipated in the form of heat. But there is another disadvantage: it must be remembered that when valves are connected in parallel with a limiting resistance in the feed leads, the removal of part of the load, due to withdrawal of one valve or to failure of its filament, will bring about a considerable rise in voltage, which may easily be sufficient to damage the filaments of the remaining valves in the receiver.

Two Eliminators; One Receiver.

Is it possible to use two entirely separate A.C. eliminators for feeding a single receiver? I ask this question because I have an opportunity of obtaining an instrument at a low price, which, I believe, on a light load, will give sufficient voltage and current for operating a power grid detector which I propose to use. My existing eliminator would be used for feeding all the valves except the detector; this would be supplied by the new instrument, which, I am told, will maintain a voltage of well over 250 when supplying 8 milliamps. M. L.

On theoretical grounds, no objection can be raised to this plan, which, indeed, confers the advantage that undesirable interaction cannot be introduced in the eliminator circuits between the detector and other valves.

Of course, it seems rather extravagant to employ a complete eliminator, with its own rectifier and smoothing circuit, etc., for feeding one valve.

o o o o

Combined Choke and Transformer Output.

My receiver includes an output choke; would it be possible to operate it without alterations or additions in conjunction with a low-resistance moving-coil loud speaker which embodies a built-in step-down transformer? J. R. L.

It is quite likely that your set would work well with this loud speaker, but it is impossible to give a definite answer to your query, as each case of this sort must be considered on its own merits, and with regard to the design of the output transformer, the inductance of the output choke, and the capacity of the feed condenser. In general it may be said that one runs a certain amount of risk in connecting a choke across a transformer *via* a condenser; this is virtually the effect of doing as you propose.

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Characteristics L.P.2.

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,, current	.2 amps.
Max. Anode volts	150
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Impedance	3900 ohms.
Mutual conductance	3.85

10/6

Characteristics P.2.

Filament volts	2
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Max. Anode volts	150
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Impedance	2150 ohms.
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13/6

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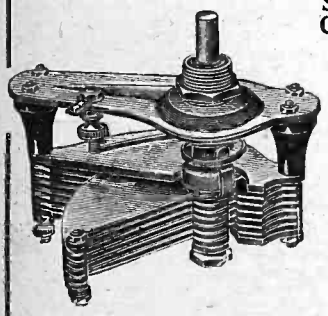

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Knob 1/- extra.

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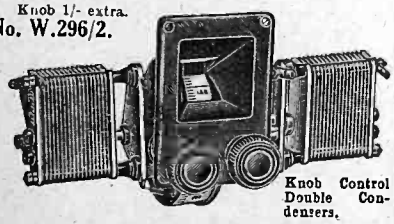

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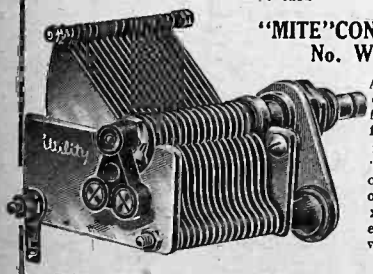

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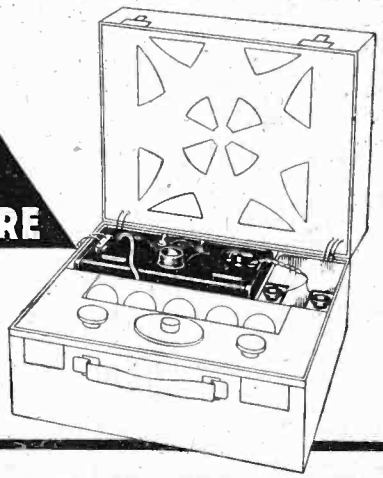

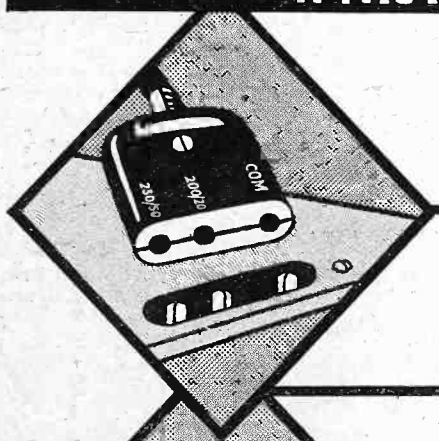

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THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made ——— & Co. payable to ILIFFE & SONS Ltd., and crossed ——— & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors. — Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

"WIRELESS World" Four, Foreign Listener's Four, or any other "Wireless World" circuit built to specification with listed components by experienced staff, work and results guaranteed.—Matlock Radio Manufacturers, Matlock House, Woodberry Grove, Finchley, N.12. 'Phone: Finchley 2837. [2358

B&J

"WIRELESS WORLD" FOUR.

Coil Screens - - 3/- each.
Valve Screens - - 2/9 each.
(with special ventilation holes and insulated top.)

Approved by "The Wireless World."

Send particulars of your requirements for

MAINS, TRANSFORMERS & CHOKES

B & J. Wireless Co.

ATHELSTANE MEWS, N.4.

Arc. 1695

WITHOUT FEAR—

Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.

Particulars from the Secretary,

HONOR OMNIA APPLEBY'S,

SUPER

Chapel St., Marylebone, London

CONTACT!

The spring loaded phosphor-bronze balls in the Benjamin Rotary Switches make firm, positive, low resistance contact at all times. The contact is always clean because of the rubbing action of the balls. It is this excellence of positive contact that has made these switches so widely specified by circuit designers.

Write for Catalogue No. 1142.

THE BENJAMIN ELECTRIC Ltd., Tariff Road, Tottenham, N.17. Tottenham 1500.

36

BENJAMIN

WIRES FOR WIRELESS

As supplied to the Leading Telephone Apparatus Manufacturers. Flexible and Instrument Cords of all types. "Connectite" Wire.

CONCORDIA ELECTRIC WIRE CO. Ltd., Trent Mills, New Sawley, Nr. Nottingham.

IMPORTANT NOTICE.

Owing to the Christmas Holidays, the next issue of "THE WIRELESS WORLD" (dated December 24th) is closing for press earlier than usual.

In accordance with the Notice that appeared last week, the latest date upon which Miscellaneous Advertisements could be accepted for the above issue was FIRST POST WEDNESDAY, December 17th.

For the issue of December 31st, advertisements for these columns can be accepted not later than FIRST POST, MONDAY, DECEMBER 22nd.

Receivers for Sale.—Contd.

END of Year Clearing.—The following slightly used material is offered subject to sale; every item will be severely tested before despatch and guaranteed in workable condition; prices quoted for receivers include set of tested valves to suit; in the case of portable receivers batteries are included.

McMICHAEL Screened Dimic Three, 3 only at 10 guineas each; Bowyer-Lowe 2-valve S.W. receiver, with coils, 10 to 2,000 metres, det. and pentode, 150/-; G.E.C. 3-valve S.W. receiver, with coils, 10 to 600 metres, det. and 2 L.F., 125/-; G.E.C. World Wide Four, 2 S.G., det., power, with 2 frame aerials, 250-2,000 metres, 340/-; another, ditto, ditto, 250/-; another, ditto, ditto, 180/-; G.E.C. Screened Three, 163/-; another, ditto, 155/-; G.E.C. 8-valve superhet., frame aerial 250-2,000 metres, 250/-; another, ditto, ditto, 215/-; Truphonic 5-valve portable Melo-Set, 170/-; Selector 4-valve S.G. portable De Luxe, 290/-; Halcyon 4-valve S.G. portable De Luxe, 295/-; another, ditto, ditto, 265/-; Baird television kit, complete, 207/6; M.L. motor generator outfit, input 240 volts D.C., output 400 volts 100 m.a. and 6 volts 5 amps., complete with output smoothing equipment and cut-out, 345/-; another, ditto, ditto, 290/-.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0340

1930 Everyman Four to Specification, Ritherdon cabinet, valves, Mazda S.G.215, remainder 6-volt, complete with Blue Spot linen speaker, £14; also Ferranti B.E.M.1 eliminator, £12; all new this year.—Box 8364, c/o *The Wireless World.* [2486

MEGAVOX Receiver, S.G.-D.E.T.-P.E.N., finest components, new P.M.24A, milliammeter, tone control, pick-up switch, Exide 160 and 4-volt accumulators, working R.K. Senior speaker, perfect; £9.—Robertson, 6, Kingscote Rd., W.4. [2506

PHILIPS 3-valve A.C. Mains, cost £28; accept £20.—7, Prebend Mansions, Chiswick. [2517

EDDYSTONE and Marconi Short Wave Receivers; offers.—2a, Salisbury Rd., Seven Kings, Essex. [2510

McMICHAEL Super-screened Portable Four, 2S.G., cost £36/15, perfect condition; £18.—Haggie, Tornadee, Murtle, Aberdeenshire. [2514

SIMMONDS BROS. are Specialising on "Wireless World" Four and Other Modern Receivers; superb workmanship guaranteed; exchanges.—38, Rabone Lane, Smethwick. [2155

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

5-VALVE Solodyne 1928 Receiver Mahogany Cabinet; Exide battery, 2-220 volts, A.C. eliminator, good order; £9.—3, Furze Lane, Purley. [2534

AMERICAN Lincoln, 2-v-2 Neutrodyne and valve, 250 to 2,000 metres, wonderfully selective; £3/5, parts worth more.—Petty, Clapham, Lancaster. [2561

STUPENDOUS Offer!!!—2-valve A.C. and D.C. receivers, new, complete!!! £4; marvellous performance!!! C.o.d.—96, Brockley Rise, S.E.23. [2539

PHILIPS 2514 3-valve Electric Receiver, 210v., not 3 weeks old, guaranteed perfect; owner making "Wireless World" Four; £16.—Manor House, Alphington, Exeter. [2544

5-VALVE Portable (National), new batteries, fully guaranteed, £8/10; 2-valve portable (Pentode) local stations—short wave—set, new batteries, £6; both equal new. Also large number "Wireless Worlds" and other radio publications, offers wanted; also quantity wire, various gauges and number of components, very cheap.—Write for particulars, Heywood, 98, Copeland Road, Rye Lane, S.E.15. [2557

1930 5-valve Receiver, 5-watt output, 400v. eliminator, all in cabinet; cost about £80, accept £20.—Broadfoot, Roselea, Hoylake, Cheshire. [2556

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ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators, by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0623 (3 lines). [1466

CHARGERS AND ELIMINATORS.

PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5, 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5, 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

H.T. Eliminator Kit, incorporating Westinghouse H.T.5 rectifier, kits consist of transformer, choke, Westinghouse rectifier; required condensers, resistance, safety plugs and sockets, and baseboard; output 20 milliamps at 120 volts, 47/6, post free; metal case for same, 3/9 extra.

ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

VORTEXION Transformers and Chokes, wound to specification; best quality components only supplied.

VORTEXION No. 4 Bobbins, 1in.×1½in., 1/3, post 2d.; 1in.×1in., 1/-, post 2d.; cast aluminium end plates, 2/3 per pair, post 2d.; No. 4 laminations for 1½in. bobbins, 6/2, post 9d.; for 1in. bobbins, 4/2, post 6d.

VORTEXION, 72, Merton Rd., Wimbledon, S.W.19. Tel.: Wimbledon 2814. [0439

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

IGRANIC Model V208A, H.T. supply unit, 4v. charger, Universal H.T. mains, complete, accumulator and valves; cost £16, price £8.—Percy, 20, Bond St., Ealing. [2499

H.T. Eliminator Kits, 175v. 25 m.a., comprising Westinghouse H.T.6 rectifier, transformer, choke, 3 T.C.C. condensers, resistance, plug, baseboard; 41/-; lists free.—Edwards, 5, Bradford St., Chelmsford. [2500

REGENTONE W.2A. 100-120-volt mains, output 160 volts at 60 milliamps, nearly new, owner purchased all mains receiver, £4/15; Mullard H.T. unit, 100-105-volt mains, nearly new, £3; Valley L.T. and H.T. charger, 210-volt mains for 2-, 6-, and 12-volt accumulators charging up to 15 amps and H.T. accumulators at 0.1 amp, £3; all above guaranteed in perfect condition.—B. V., 10, Parsifal Rd., Hampstead, N.W.6. [2526

WESTINGHOUSE All-Metal Rectifier, 200v., 100 m.a., 9v. 2 a.m., 45 v.g.b. charge accumulators, cost over £30; offers, or exchange microscope.—W. H. Price, Reservoir House, Longsett, nr. Sheffield. [2508

ECKO All-power Unit, C.2A., 200-250-volt mains, 40-100 cycles, as new; £8/10.—Pinfold, 58, Camp Lane, Handsworth, Birmingham. [2519

SOUND SALES.—Genuine British Stalloy Stampings.

NO. 30 for "Wireless World" choke, 1½in. core, 4/6, post free; 1in. core, 3/6, post free.

NO. 4 Stalloy Stampings. 1½in. core, 6/-, post free; 1in. core, 4/2.

CLAMPS and Bolts for Above, 1/6 and 2/-.

WE Can Supply Any Wire, bobbin, terminal strips, etc., c.o.d.

"WIRELESS World" Constant Inductance Chokes; 15/-; repairs a speciality; see our speaker advertisement.

SPECIAL Filament Transformer, 200-240 volts, tapped primary, 4 volts, 4 amps., centre tapped output, metal shrouded, shockproof terminal; 15/-.

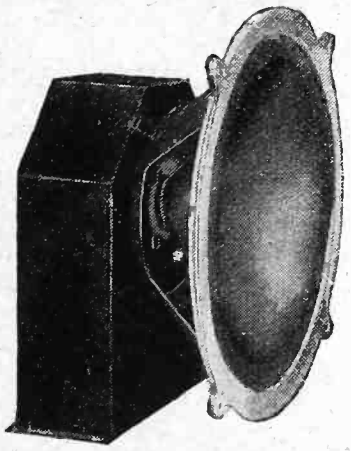
WE Guarantee All Transformers Undergo a 4-hour Test on Overload; for insulation, correct voltage and freedom from buzzing, the safety factor is ample for all requirements.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2492

BRYCE'S are Supplying Mains Transformers to Manufacturers and Constructors all over the Country.—Huge demand for AB.64, output 250-0-250v. 80 m.a., 2-0-2v. 1a., 2-0-2v. 3a., 3-0-3v. 1a.; price 24/6; post 1/-; guaranteed; order early; lists free.—Bryce's, 54, Dawson St., Bury, Lancs. [2548

The BEST of all the "Permanents"!!

BAKER'S



A NEW PERMANENT MAGNET MOVING COIL SPEAKER *with*

★ LINEN ★

DIAPHRAGM

The biggest advance yet made in Sound Reproduction with Permanent Magnets. Gives amazingly realistic reproduction of both speech and music . . . . a brilliant treble and a fine true natural bass.

SUPER-POWER, Cobalt Steel; Permanent Magnet Speaker; Weight 13 lbs. . . £6.0.0

STANDARD, Cobalt Steel; Permanent Magnet Speaker; Weight 8 lbs. . . £4.10.0

Music Lovers—

write now for new and enlarged 32-page booklet on "How to get Realistic Reproduction"

IT IS FREE

and yours for the asking.

BAKER'S 'Selhurst' RADIO

Offices:

89 SELHURST ROAD, S. NORWOOD, S.E.25.

Works and Demonstration Room:

42 CHERRY ORCHARD ROAD, E. CROYDON.

Chargers and Eliminators.—Contd.

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3; 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformers for the New Westinghouse Units; please write for list.

SAVAGE'S New Foreign Listeners' Four Equipment.—Transformer; N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32/0, 20/-.

SAVAGE'S "Wireless World" Four Equipment, mains transformer, W.W.4, 34/-; smoothing and bias chokes, type W.W.4C, 16/- each; centre tapped output choke, L.C.36P.G., 19/6.

SAVAGE'S Mains Transformer, B.T.4, 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps., 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S Have Moved to Larger Premises; please note new address: 292, Bishopsgate, London, E.C.2. Telephone: Bishopsgate 4297. [1784

FERRANTI BEM1, £16/10; eliminator, £10; also other Ferranti components, cheap.—Cattanes, 97, Marylands Rd., London, W.9. [2513

MAINS Transformers, 240+240, 80 m.a., 4v. 2a., 4v. 5a., 25/-; 240v.+240v., 4v. 4a., 5v. 1.6a., 25/-; 135v., 50 m.a. 4v., 4a., 19/6; smoothing chokes, from 10/-; condensers and eliminator parts.—Challis, below.

SPECIAL Transformers Made to Specification.—Any above 7 days' approval or deposit.—Challis, 22, Park Rd., Rugby. [2531

CABINETS.

ARTCRAFT Cabinets, illustrated list free; radiograms, from 79/6; unbeatable value.—Artcraft Works, Grant Rd., Croydon. Established 1925. 'Phone: 1981. [1814

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.

DIGBY'S Cabinets, fitted with Radion or Resiston ebonite if required.

DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.

DIGBY'S Cabinets Made to Customer's Own Designs.

DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [1479

KAY'S Cabinets.—Exclusive practical models in radio and radiogram cabinets, 50% cheaper than elsewhere, used and recommended by the most distinguished and discriminating radio experts; a range of 60 designs to select from; illustrated price lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Walthamstow 1626. [1789

CRAFTEASE Cabinets, for wireless sets and gramophones, ready to assemble or assembled; lists free.—Craftease Works, J. Mendip Industries, Winscombe. [2412

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

APPLEBY Coils for "Wireless World" Four, with switches, 36/- set of four, post free; screen for above coils, 3/3 each, post free.

APPLEBY Screen Tubes for Screened Grid Valves, ventilated and insulated at cap aperture; 2/9 each, post free; suitable for "Wireless World" Four, and all modern circuits.

APPLEBY Midget Binocular, iron cored H.F. chokes suitable for "Wireless World" Four and all modern circuits; 3/9 each, post free.

APPLEBY Standard High Inductance H.F. Choke for All-purpose Use where high inductance and low self capacity are essential; 6/6 each, post free.

APPLEBY 600 and 1,000 ohms Midget Resistances for All Decoupling Purposes; 1/6 each, post free.

APPLEBY, Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines, private exchange). [0343

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Coils, Transformers, Etc.—Contd.

BAND Pass Three Coils, 30/- set, "Wireless World" specification; slotted formers for winding, 8/6 set; grooved primary supports, 2/- set; all D.C. Three formers, 8/- set; decoupling resistances, 1/6 each; all post free.—Groves Brothers, Coil Manufacturers, St. Mary's Place, Shrewsbury. [2269

COILS.—Band Pass superheterodyne, complete set, 30/-; Band Pass Four, 25/-; Band Pass Three, 35/-; "Wireless World" Four, with screens, switches, 52/-; c.o.d.—Smith, 3, Park Parade, Harlesden, N.W.10 [2344

MAINS Transformers to Supply 3- or 4-valve Sets, 25/-; chokes, 15/-; these transformers give guaranteed outputs, 200v. 60 m.a. on load, quality second to none; traders and wholesalers, you need these.—Write Eric Cookson and Co., 14, Cambridge Rd., Blackpool. [2529

GRAMOPHONES, PICK-UPS, ETC.

HARLIE Pick-up, latest model, 37/- list, with volume control, unused; 25/-.—Adams, 3, Highlands Gardens, Ilford. [2511

B.T.H. Pick-up and Arm; 30/-.—89, Darfield Rd., Crofton Park, S.E.4. [2516

TRANSMITTERS.

M.16 Igranic Metal Rectifier, unused, output 7.5v. 3a., 20/-; set Colvern short wave coils, with mounts, 10/-; 20 Quartz lenses, oscillate without reaction, 3/- each, or 40/- lot.—Jeapes, 2, Salisbury Villas, Cambridge. [2536

VALVES.

AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required)

FILAMENT Volts 6, plate volts 400 (maximum), grid bias 84 volts (approx.), impedance 800 ohms, amplification factor 3.8, mutual conductance 4.35 m.a./volts; price now reduced to £5; see article "The Wireless World," 24th July, 1929, then send to North London Valve Co., Ltd., 22½, Cazenove Rd., Stoke Newington, London, N.16 [0341

THE Best of American Tubes, Diatron brand.—Sole agents, Perry Co., 32, Dawes Rd., Fulham. [2537

WIRE.

WIRE.—All gauges from 14 to 47, British manufacture, at less than wholesale prices; send for list.—Warbrook, Honley, Huddersfield. [2542

LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition: see displayed advertisement on page 15. [0231

LATEST B.T.H. Moving Coil, 10in. cone, D.C., £5/10; Blue Spot, 66R, 26/6, as new.—Bowley, 16, Blenheim Crescent, Kensington, W.11. [2469

CELESTION Z.20, £7/15, as new, what offers?—Chapman, 93, Campden Crescent, Chadwell Heath. [2504

EPOCH Permanent Magnet Moving Coil Speaker, P.M.99; price 85/-.—Write Box 8416, c/o *The Wireless World*. [2521

MARCONIPHONE Moving Coil, 6-volt, in experimental cabinet, reproducing Tom Jones at this moment perfect; £4.—"Corone," St. Martin's, Oswestry. [2522

CELESTION Z.20 Speaker, in oak, as new, cost £8, bargain, £4/15; also 6-volt 80 actual accumulator, specially built for operating moving coil, £1/5.—Mebes, 144, Great Portland St., W.1. [2518

REALISTIC SPEAKERS, wood diaphragm, ingenious construction, unrivalled results, true to its name; chassis, 27/6, fit any unit; complete speakers, £3/10 to £25; write for particulars, demonstrations daily.—Realistic Speakers, 72, Penton St., London, N.1. [2308

SOUND SALES Specialise in Moving Coil Speaker Repairs.

SOUND SALES Supply Replacement Mains Transformers from 15/-

SOUND SALES Convert D.C. and Battery-excited Speakers to A.C.

SOUND SALES.—Amazing Christmas offer: Magnavox Little Giant moving coil speakers, complete, in oak, mahogany, or walnut finish cabinet, also special gold or fancy cabinet, guaranteed free from box resonance, 6-volt and 220v. D.C. models; £3/3; c.o.d. if required.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2365

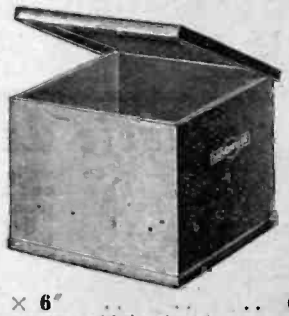
£2.—Baker's moving coil speaker, 6v. pot, .6 amps., very sensitive.—Jamieson, Wem. [2543

BAKER'S Permanent Magnet Moving Coil Speaker, 1930 model, Camco oak cabinet, guaranteed perfect; £4/10.—"Anne Port," Hawes Lane, West Wickham. [2535

B.S.A. Kone, cost £7/7, perfect condition; £3/10.—Cannon, 20, Arbuthnot Rd., New Cross, S.E. [2533

Write for illustrated Catalogue to
GARNETT, WHITELEY & CO., LTD., LIVERPOOL.

MAGNUM SCREENING BOXES
are specified for
THE "BAND-PASS" SUPERHETERODYNE



6½" × 6½" × 6" complete with baseboard.	6/-
4½" × 6½" × 6" complete with baseboard.	5/-
I.F. Transformer Box complete with baseboard.	4/-
S.G. Screening Box	3/-
Vertical Shield with wood support	2/-
Panel Brackets per pair	2/-

We specialize in this Receiver, also the "Band-Pass" 4 and "Wireless World" 4. These can be supplied as constructional kits or ready wired and tested. Full particulars, with list of leading short wave stations, free on request.

BURNE-JONES
AND COMPANY, LIMITED,
"Magnum" House, 296, Boro' High Street, London, S.E.1.
Telephones: Hop 6257 & 6258.

Loud-Speakers.—Contd.

EPOCH Moving Coil Speakers.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—Have you heard the Domino model?

EPOCH.—The amazing model 101 (Domino).

EPOCH.—If you have not, take the first opportunity of doing so.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—No matter what loud-speaker you have heard, your decision will be firm.

EPOCH.—You will not hesitate, you will not ask your friend, you will not ask an expert.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—You will be glued to the spot. You will be hypnotised.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—And when you recover and find you have been awake, you will join in the Joyous Epoch Chorus, repeated frequently at each paragraph.

EPOCH.—The amazing model 101 (Domino).

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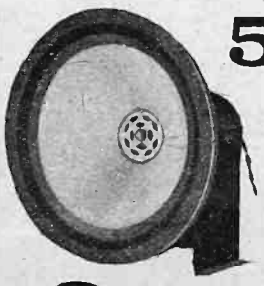

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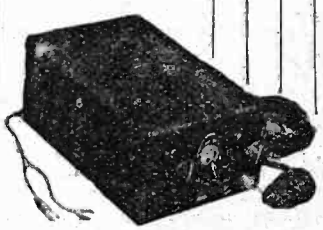

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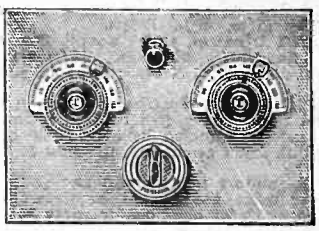

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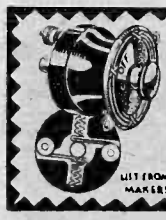

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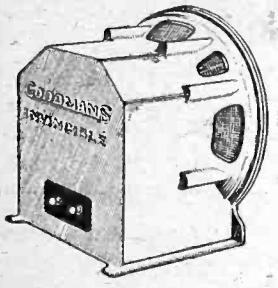

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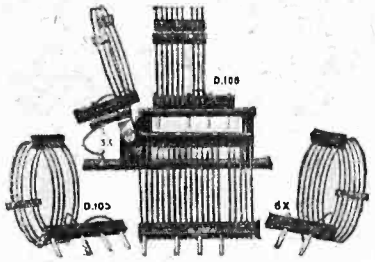

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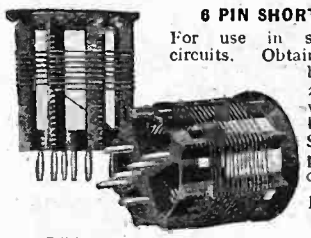

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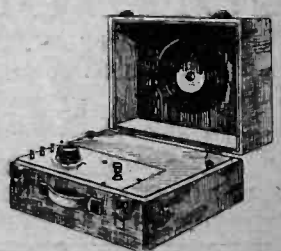

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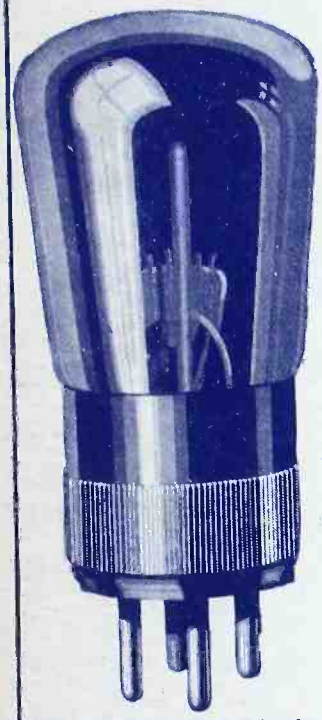

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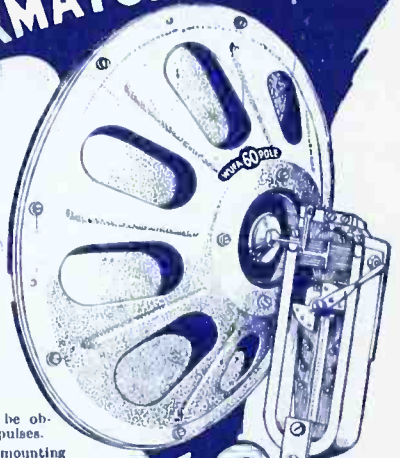

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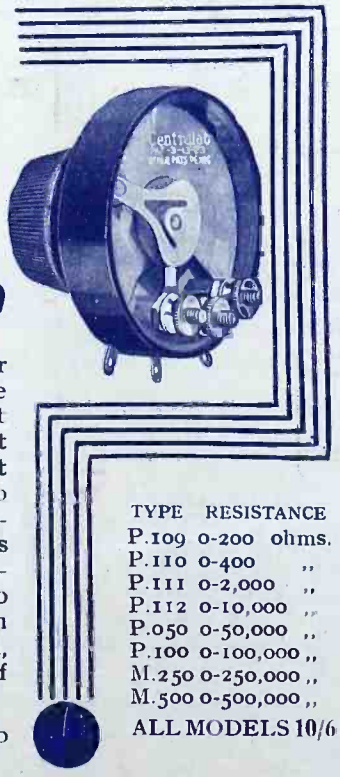

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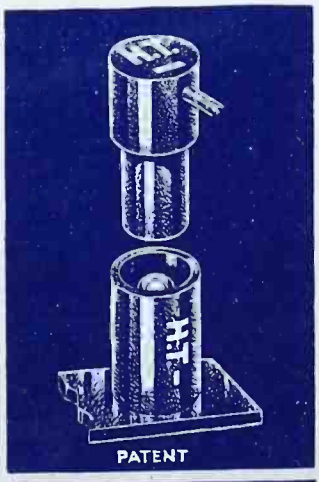

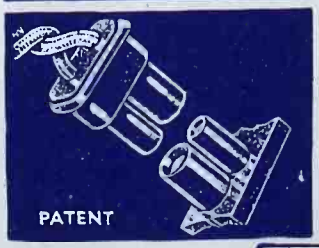

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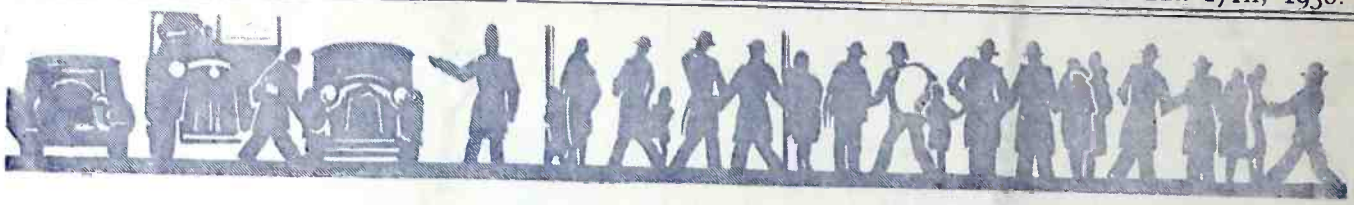

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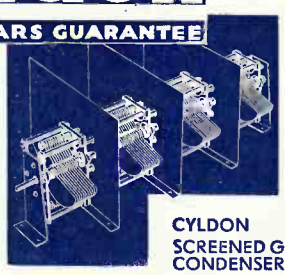

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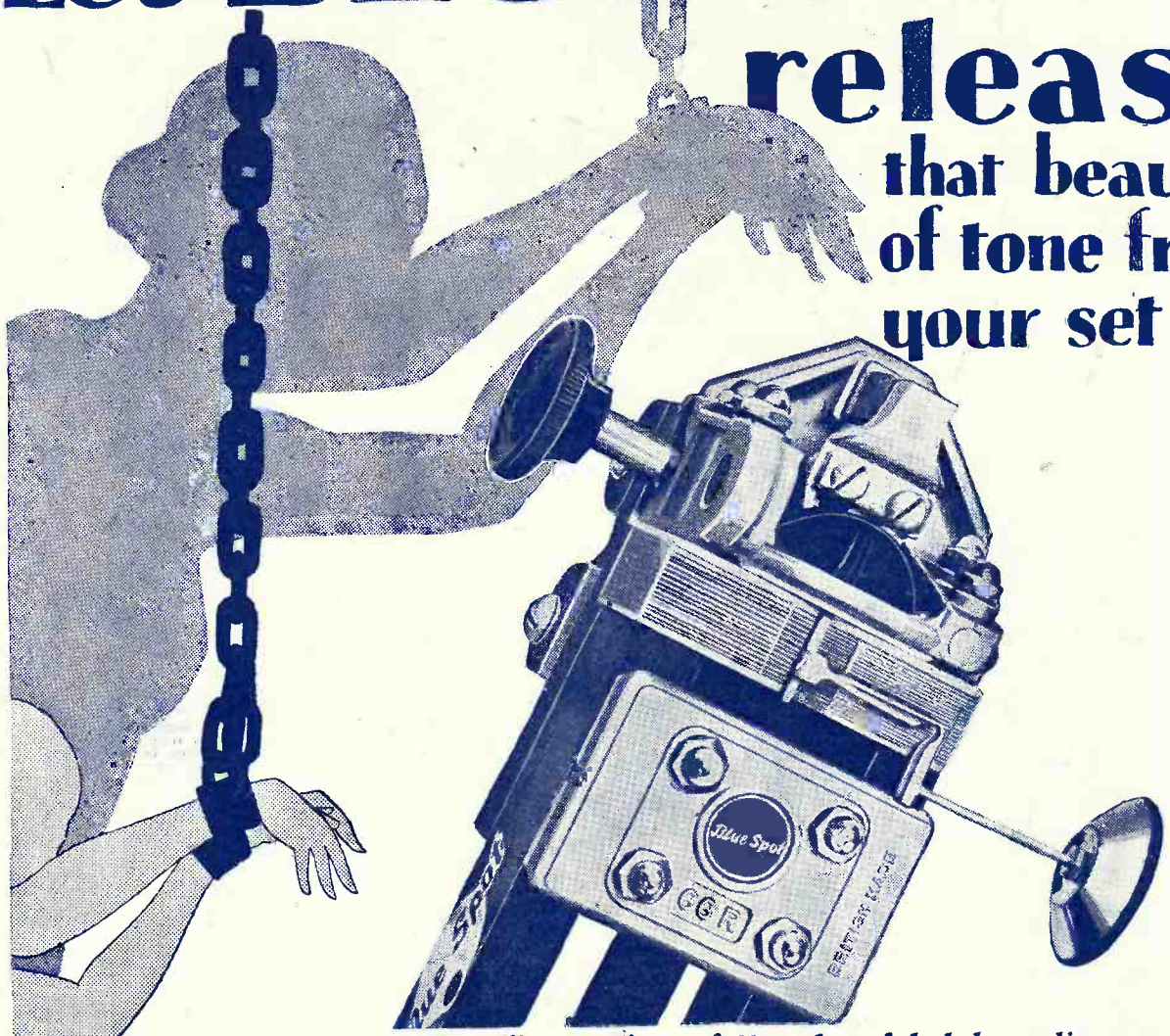

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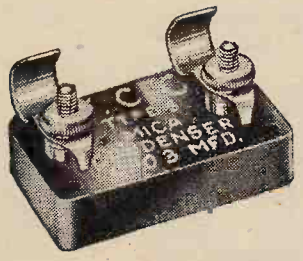
When a young shepherd boy, bitten by a mad dog, was brought to him for inoculation, Louis Pasteur, the great French scientist, was tormented by indecision. Should he put his life's work to the test? Would it save—or end—the boy's life? He decided, the boy was saved, and long years spent in doing one thing and doing it well, were rewarded with success.

It is this same spirit of "doing one thing and doing it well" which has, for years, been behind all T.C.C. endeavour. That is why T.C.C. have never made anything but Condensers, and why T.C.C. Condensers are unmatched—for accuracy and dependability.



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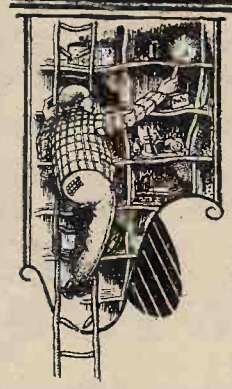

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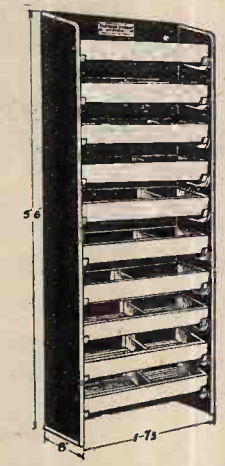

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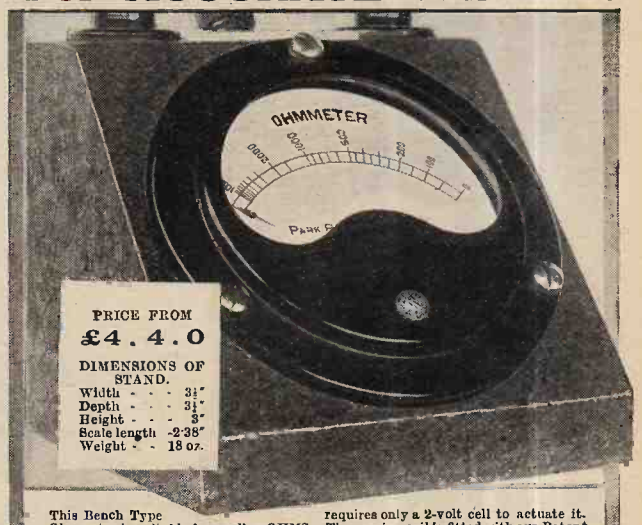

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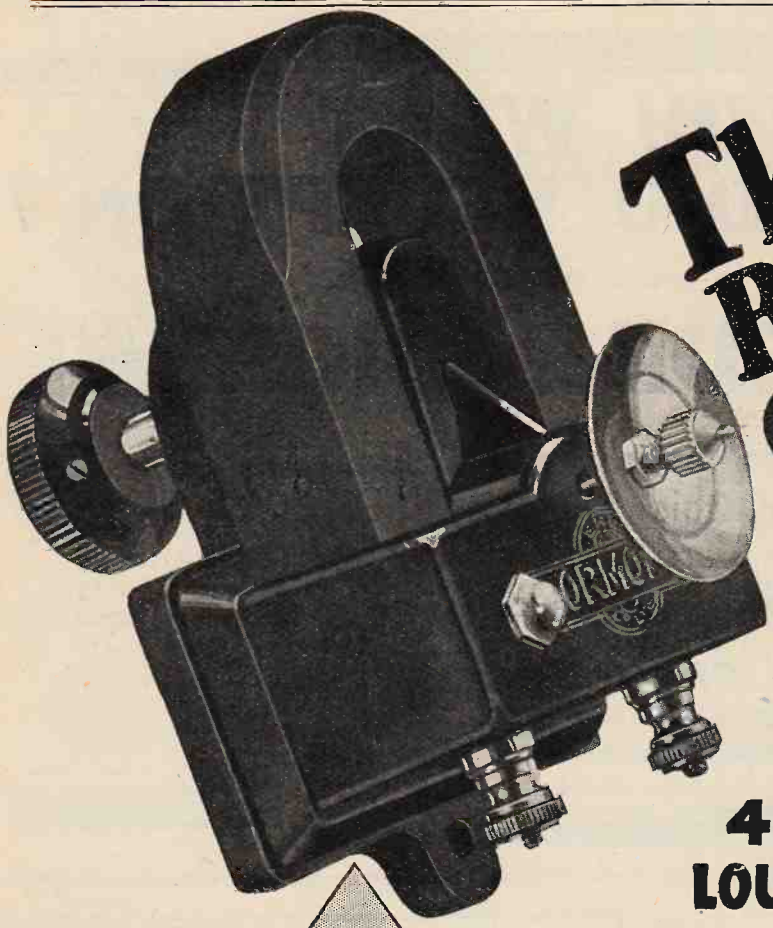

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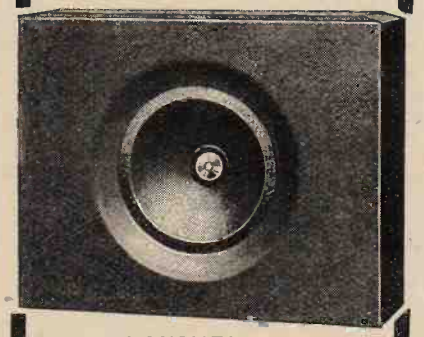

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The Wireless World and Radio Review

DIARY for 1931

The demand for this attractive pocket volume has been so great that the Publishers have to announce that they are unable to supply any further copies.

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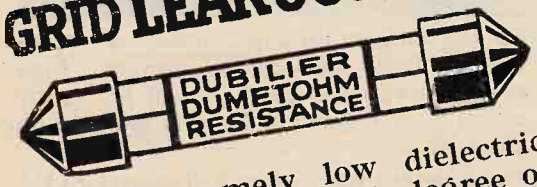

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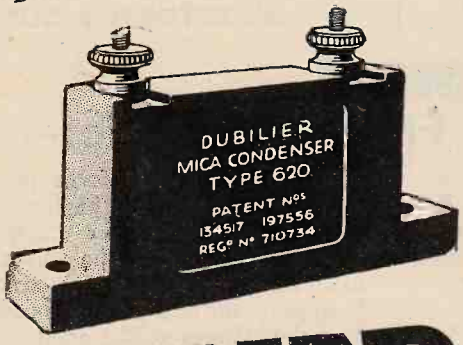

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We thank You for your Votes at Olympia, and should like to wish You All

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AND HAPPY NEW YEAR

The Radio Gramophone Development Co.,
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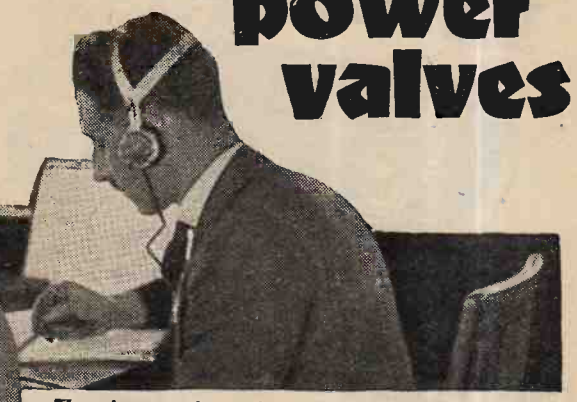
A scene in the Control Tower at Croydon. Operators dealing with aeroplane location reports.

Efficiency in super power valves



To the modern listener, quality of reproduction is of supreme importance. Even the finest sets and speakers will not satisfy unless pure majestic volume is available on demand.

Fit an output valve which will reproduce the full grandeur of a famous military band or the delicate overtones of a violin with equal perfection.

A Marconi super power Valve is made for every set, and in sizes for any conceivable volume. The correct type in any receiver will give new interest to radio and new realism to records.

MARCONI SUPER POWER VALVES STAND ALONE FOR LONG LIFE—EFFICIENCY AND GENEROUS UNDISTORTED OUTPUT.

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	Fil. Volts.	H.T. Volts max.	Amp. Factor.	Imp.	Mut. Cond.	PRICE.
P2	2	150	6.5	2300	2.8	13/6
P2/B	2	150	6.5	1850	3.5	13/6
P240	2	150	4.0	2500	1.6	13/6
P425	4	150	4.5	2300	1.95	13/6
PX4	4	200	3.5	1050	3.3	22/6
P625	6	250	6.0	2400	2.5	13/6
P625A	6	200	3.7	1600	2.3	13/6

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From the Experts :—

Because of their longer life—clearer tone—greater range and volume—Marconi Valves are used by The B.B.C., Imperial Airways, Croydon Control Tower, Metropolitan Police, Trinity House Beacon Stations and Lightships, Empire Wireless Communications, Large Passenger Liners, etc., etc.

From the Public :—

"I am writing to inform you that from March, 1924, until the beginning of this year I have used one of your V.2.A 2-valve long range sets, and that the valves on this set have been in continual use to my personal knowledge for nine years and have never been replaced, always giving good results. . . . This set came into my possession second-hand in 1924, but to my knowledge it was in use for two years before that and then was bought second-hand."—H. G. L., Radstock.

Buy MARCONI VALVES

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THE VALVES THE EXPERTS USE

The Wireless World AND RADIO REVIEW (18th Year of Publication)

No. 591. WEDNESDAY, DECEMBER 24TH, 1930. VOL. XXVII. No. 26.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Alternative Long-wave Programmes.

WE are glad to be able to publish, under Correspondence in this issue, a letter from Mr. Noel Ashbridge, Chief Engineer of the British Broadcasting Corporation, which is a reply to the plea put forward by *The Wireless World* that the B.B.C. should take active steps in an endeavour to obtain a second long wavelength for this country, in order to give an alternative programme on the long waves.

The Chief Engineer's letter points out the difficulties which have to be faced in considering this question, but the tone of the letter generally indicates, in our view, sympathetic interest in the proposal. The importance of long waves, due to their low attenuation, is stressed, but it is pointed out that there may be countries other than our own having a better claim to the use of long waves for broadcast transmission on account of the hilly nature of their territory. It would seem to us, however, that it might be possible, if a station cannot be fitted into a channel exclusively its own, to arrange for it to share a wavelength with another station as remote as possible geographically. Whatever the future may bring forth, we hope that in the present the B.B.C. will take to heart our recommendations that the importance of the long-wave station should not be overlooked, and that the transmitter should always be fed with the best programme items. We had felt a little while back that there was a tendency to neglect 5XX and use it for what may be described as "odd jobs," rather than to make it a really national transmitter distributing the best of the programmes.

Whilst on the topic of the Daventry long-wave station it is opportune to point out that comments which have reached us during the past few months seem to indicate that there has been a falling-off in power of this transmitter, or that an increase in the power of Continental long-wave transmitters has tended to influence listeners into thinking that Daventry was less powerful than formerly. In any case, since one long wavelength is definitely ours, there would seem to be every justification for seeing to it that we make the very most we can of the transmitter, if necessary increasing its power so that it at least compares favourably in range with the long-wave transmitters on the Continent.

We cannot afford to overlook the importance nationally of maintaining a station which has a considerable range. It cannot be said of the shorter wavelength transmitters in this country that they cover the Continent and can be readily received, but the long-wave transmitter is very generally listened to abroad. Our broadcasting will be judged very largely abroad on the performance of the long-wave transmitter and the programme matter. Broadcasting extends to-day so far beyond the confines of the home country that it is a dominant factor in international relationships, and it might truly be said that every transmitter which can be received in foreign countries is an ambassador of the ether.

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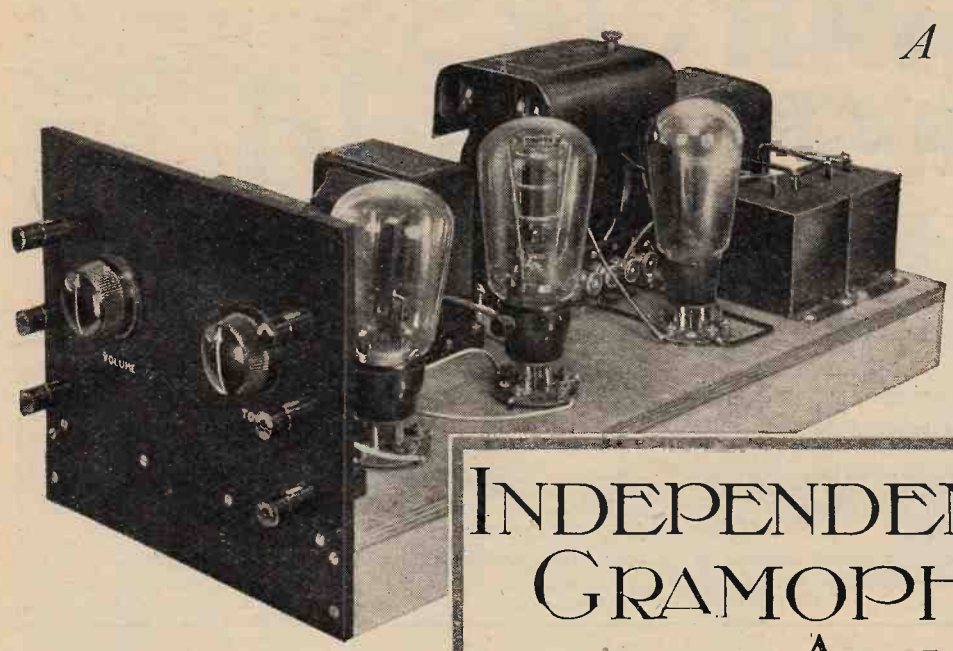
BROADCAST BREVITIES.
LETTERS TO THE EDITOR.
READERS' PROBLEMS.

A High Quality Instrument with a Tone-corrected Output.



INDEPENDENT GRAMOPHONE AMPLIFIER

By N. P. VINCER-MINTER.

THIS gramophone amplifier has been designed by the writer for his own personal use, and this fact accounts for its rather elongated shape as it is intended to fit into a suitable space in an existing console type of gramophone. The entire battery eliminator—L.T., H.T. and G.B.—is built as a separate unit and is mounted at the back of the amplifier. There is no reason at all why the eliminator should not be mounted at the side of the amplifier or underneath it, thus forming a double-deck arrangement should either of these two methods of layout suit the intending constructor better. The amplifier, as already indicated, derives all its power from A.C. mains, but those readers who are confined to the use of batteries need only omit the eliminator portion and add the necessary battery terminals in order to make the instrument suitable for their use.

In order to assist battery users whose technical knowledge may be slender, a dotted line has been drawn through the theoretical diagram showing exactly where the amplifier portion—which is on the left of the dotted line—leaves off, and the eliminator begins. A glance at the photographs shows clearly the division between the amplifier baseboard and the eliminator baseboard, both of which are screwed to the top of a pair of battens which run the full length of the whole instrument.

Since all self-respecting sets nowadays possess a jack or some similar arrangement for rapidly connecting up a pick-up, there would at first sight seem to be no object in building a separate amplifier intended for gramophone work alone. In the writer's case, however, the relative positions of the wireless set and the gramophone would mean long pick-up leads if the L.F. side of the receiver were to be pressed into service as a gramophone amplifier, and there are probably quite a number of people similarly situated. Long pick-up leads always cause high-note attenuation, and in many cases they pick up hum or other objectionable noises from the mains. In addition, lengthy pick-up leads will sometimes seriously mar quality, owing to the fact that the amplifier is brought into a state of incipient L.F. oscillation, more especially if loud speaker leads are allowed to come into proximity to the leads running between pick-up and amplifier. Lead-covered wire is usually sufficient to cut out induction noises from the mains and feed back from the loud speaker leads, but it increases high-note loss. At any rate, the fact remains that a remarkable improvement in the quality of gramophone reproduction always results from the adoption of short pick-up leads and well merits the expense of a separate amplifier.

Advantages of the Power Pentode.

The writer's aim in designing this instrument has been the production of a very high degree of quality at sufficient volume to fill a room whose dimensions are 20ft. by 15ft. In order to achieve this end trouble and expense were not spared, and many arrangements were rigged up and scrapped before the instrument which we are going to discuss in this article was finally built. The writer ordinarily uses a moving-coil loud speaker, and if this is fed with one watt of *undistorted* power from the last valve it will provide adequate volume. Since, however, it was desired also to use an inductor loud speaker at times, it was decided to choose an output valve capable of giving somewhat more than one watt, since, rightly or wrongly, it is the writer's experience that the inductor type of instrument requires rather more electrical input for a given acoustic output than does the average moving-coil instrument. Although this difference in input power demand is usually less than a

Independent Gramophone Amplifier.—

quarter of a watt, it was decided to increase the output by an amount not less than this, since it is always better to work with an adequate reserve of power.

The output valve chosen will actually give a greater power output than we require, as reference to *The Wireless World* Valve Data Sheet will show. Since the theoretical diagram distinctly indicates that an indirectly heated pentode valve is used in the output position and reference to the Data Sheet mentioned shows that this valve is unique, there is no need to mention it by name. The die-hard anti-pentodist will undoubtedly point the finger of scorn at the fact that the maximum value of grid bias which can be applied to the valve is only ten volts, and its permissible grid swing will, therefore, be very limited and quite unsuitable for an output valve. A simple analogy will show the absurdity of this argument. If it so happened that somebody invented an entirely new type of internal combustion engine which was so economical in fuel consumption that it would take only a pint of petrol to propel a car from Land's End to John o' Groat's, we should not point the finger of scorn at the smallness of the fuel consumption, but should, on the contrary, take pride in the large output in the matter of distance covered which we received in exchange for a small input in the form of petrol. We ought in exactly the same manner to take pride in the large output in the form of undistorted power which the valve gives in exchange for so small an amount of input voltage. It will be seen from this that the whole attitude which is normally taken up towards the smallness of the grid swing of many pentode valves is entirely wrong.

The pick-up which the writer normally employs has a comparatively low R.M.S. voltage output, but let it not be thought that it was this that determined the type of output valve. The particular valve employed would have been chosen in any case by the writer, partly because it gives just about the undistorted output required, but chiefly because it is so much more amenable to tone adjustment than is a triode. The method of tone correction used was first employed by W. I. G. Page in a receiver described earlier this year,[1] and since this question was fully discussed in that article, no attempt will be made to deal with it here. It will only be pointed out that although the values shown for the tone-correcting components C_3 and R_3 are correct for many loud speakers, more especially those of the moving-iron type, the condenser value will not hold good for all loud speakers; a value of 0.005 mfd., for instance, will be better in the case of certain moving-coil instruments. Readers might also be reminded that this condenser serves a vital purpose other than that of tone correcting, and this is also discussed in the article to which reference has already been made.

With regard to the special tapped pentode choke, it will, of course, be realised that alteration of the tapping varies the step-down ratio given by it, and, therefore, experiment should be made to see which tapping is best suited to the particular loud speaker which is to be used with the amplifier. If a triode output valve is used the choke can be connected up in the conventional manner, the intermediate tappings being ignored. With regard to the choice of a valve for the first position, this depends to some extent on the output of the pick-up, and the M.H.L.4 valve which is used by the writer is only one of many valves which may be employed. If the output of the pick-up is exceptionally small an A.C./H.L. valve is suggested. Neither of the two valves, of course, will cause any serious wilting of the primary inductance of the intervalve transformer,

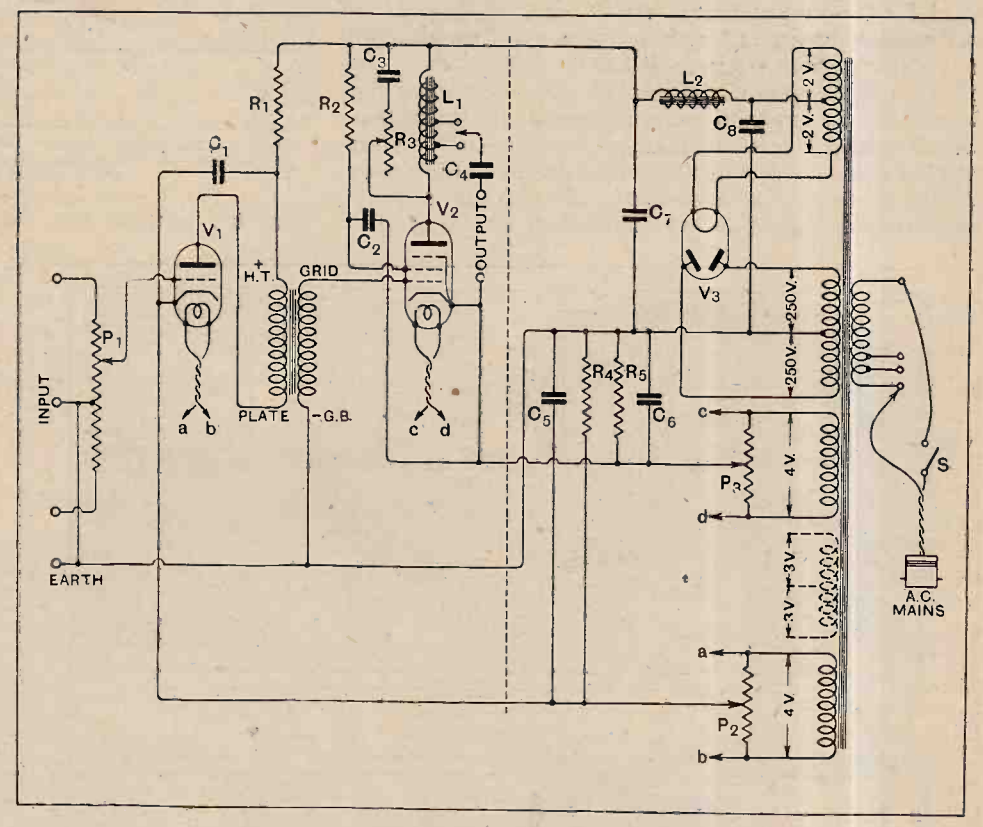


Fig. 1.—The theoretical circuit diagram. Values are as follows: P_1, 1 megohm; P_2 and P_3, 50 ohms; R_1, 20,000 ohms; R_2, 10,000 ohms; R_3, 25,000 ohms; R_4, 750 ohms; R_5, 250 ohms; C_1, C_2, C_4, C_5, and C_6, 2 mfds.; C_3, 0.01 mfd.; C_7, and C_8, 4 mfds.

[1] "The Power Pentode-Two," May 7th, 1930.

Independent Gramophone Amplifier.—

since it is of a type specially designed for use in the anode circuit of a valve having a liberal plate current, and it does its job extremely well.

Coming to the question of grid bias, it will be noticed that each valve is fed from a separate heater winding on the transformer, so that a separate grid biasing resistance is employed for each valve. Since there are two other methods whereby "automatic" bias could be applied to this amplifier, it may well be asked why this particular method was chosen. Briefly, it may be said that it was decided upon because it cannot cause any trouble anywhere, and this cannot be said of the two other ways in which "free bias" could be obtained.

Of these two remaining methods the most obvious is to use one biasing resistance, the value of which is calculated for the output valve—which, of course, requires the greatest amount of bias resistance—and then to make a suitable tapping point on it for the other valve. In practice, if the grid circuits are suitably decoupled the system can be made to work quite well, but in certain cases incipient L.F. oscillation sufficient to take the keen edge off quality will sometimes occur in spite of the most careful decoupling arrangements. The use of entirely separate biasing resistances will eliminate all risk of this.

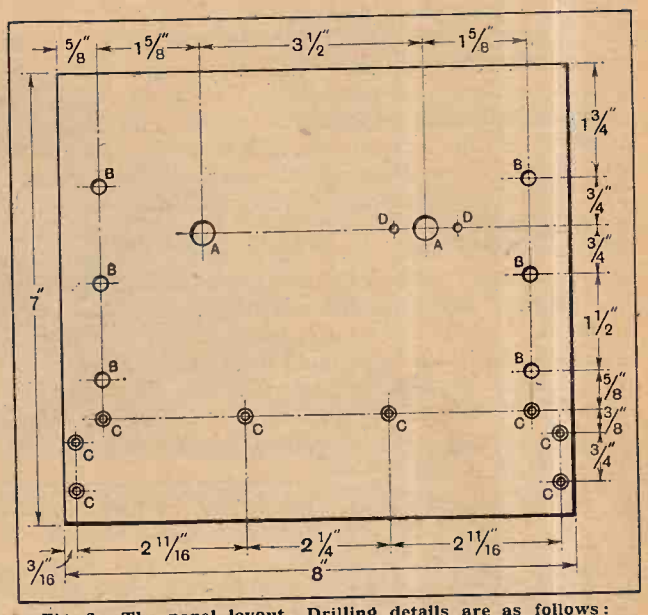


Fig. 3.—The panel layout. Drilling details are as follows: A, ⅜in. dia.; B, 7/32in. dia.; C, ⅛in. dia., countersunk for No. 4 wood screws; D, ⅛in. dia.

Now, the simplest way of providing separate biasing resistances is to insert them in series with the cathode leads, and in one amplifier which the writer built about eighteen months ago, he did this, but soon had cause to regret it. Hum was produced and the insulation between the cathode and the heater of the valve soon showed signs of wilting. Correspondence with the valve makers elicited the fact that it was undesirable to create a difference of potential between the heater and cathode in this manner. Valves are now much better in this respect, and it is possible to use resistances in the cathode leads; at any rate, in the case of valves requiring only two or three volts bias. Since transformers with a multiplicity of heater windings are now available, the writer thought it inadvisable to run any risks, however, and he accordingly adopted the arrangement used, as this is quite trouble-free. It is a pity that these transformers are not more readily available. If we used a separate

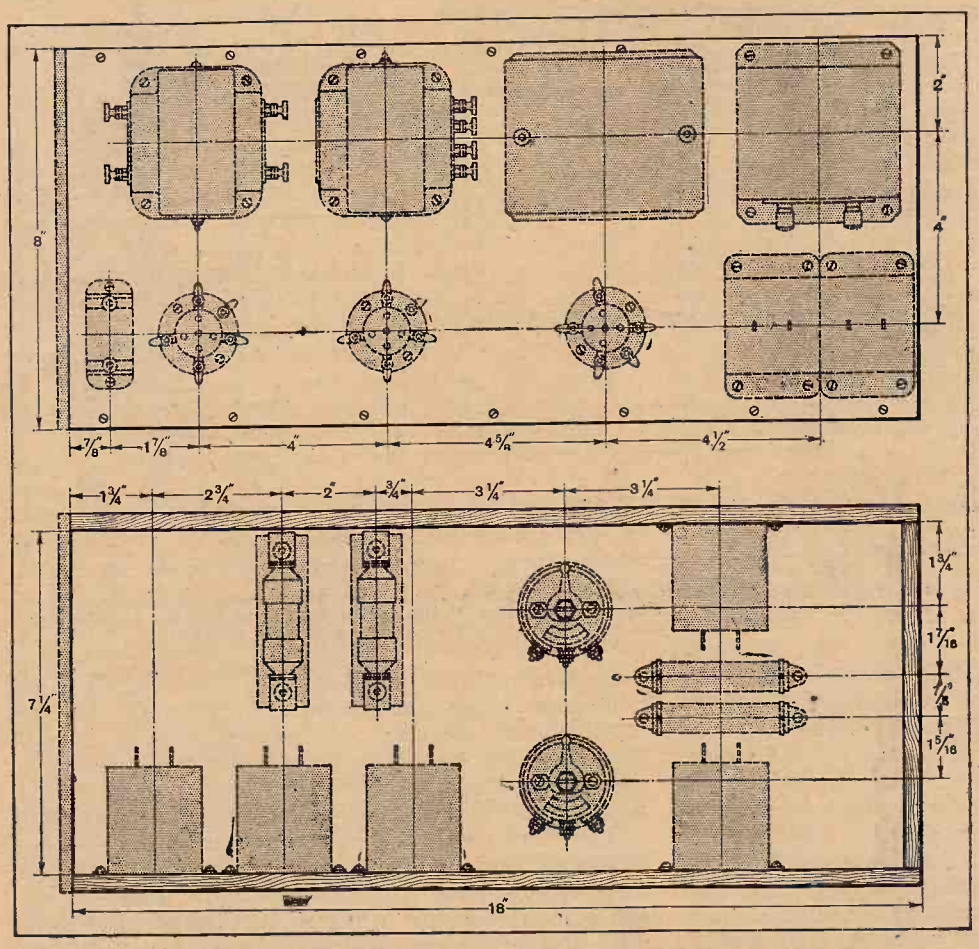


Fig. 4.—Layouts of the upper- and under-side of the baseboard.

LIST OF PARTS.

1 Baseboard, 18in. × 8in., 5-ply wood.
2 Strips of 5-ply wood, 18in. × 1½in.
1 Strip of 5-ply wood, 7½in. × 1½in.
1 Piece of ebonite, 7in. × 8in. × 3/16in.
1 Multi-volt power transformer (Varley, E.P.14).
1 Heavy duty L.F. intervalve transformer (Varley, D.P.3).
1 Pentode output choke (Varley, D.P.9).
1 Smoothing choke, 28/14 henrys (R.I., DY.11).
3 Valve holders, 5-pin (Clix, "B").
1 Volume control (Magnum Dissolver).
1 Variable resistance, 25,000 ohms (Colvern Colverstat).
1 Fixed resistance, 250 ohms (Colvern).
1 Fixed resistance, 750 ohms (Colvern).
1 Anode resistance, 10,000 ohms, with holder (Dubilier, Horizontal Duwirohm).
1 Anode resistance, 20,000 ohms, with holder (Dubilier, Horizontal Duwirohm).
2 Pre-set resistors, 50 ohms (Igranic, 2241/18).
2 Fixed condensers, 4 mfd., 500-volt D.C. test (T.C.C.).
5 Fixed condensers, 2 mfd., 500-volt D.C. test (T.C.C.).
1 Fixed condenser, 0.01 mfd. (Dubilier, 610).
6 Shrouded plugs and sockets (Belling and Lee).
1 Ivorine Torpedo switch (Grafton, 58/22).
Lamp adaptor, flex, screws, systoflex, wire, etc.

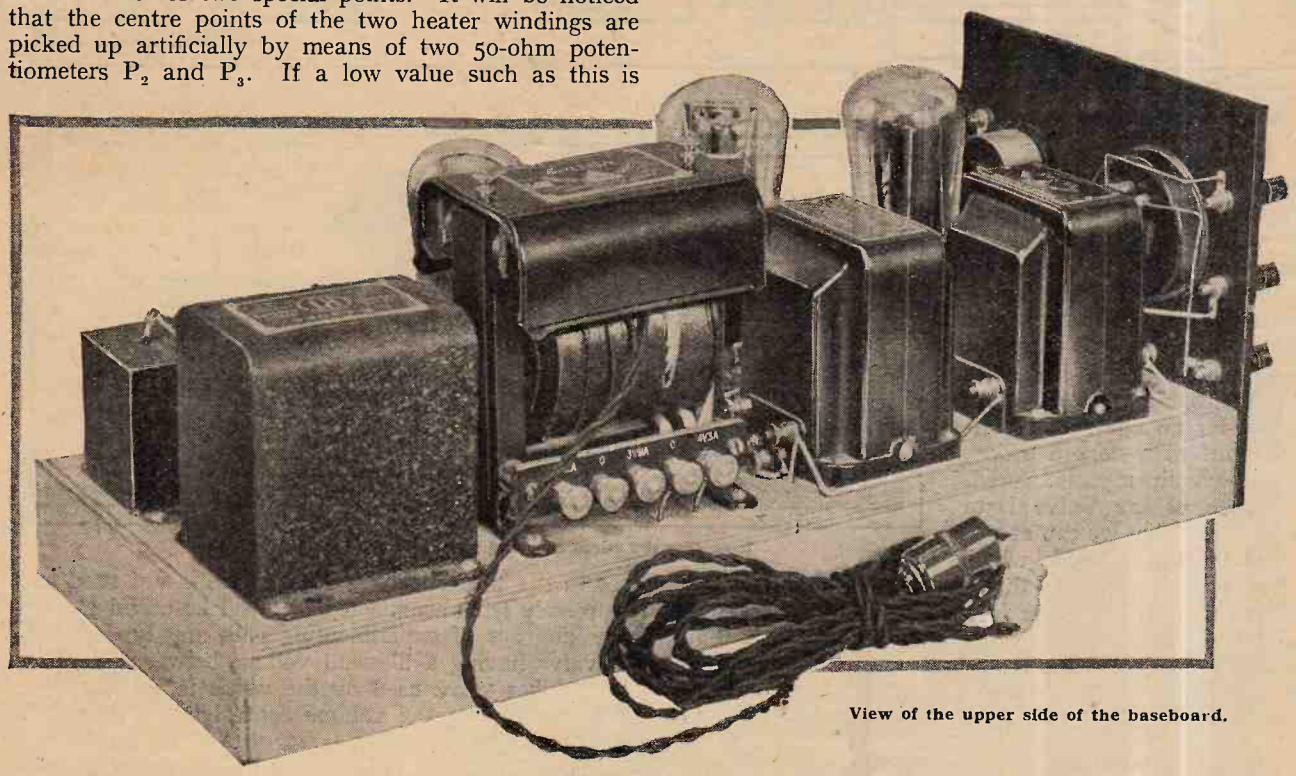
Approximate cost of parts (excluding valves), £9 10s.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed, and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

heater winding for each valve in a multi-valve set we should not only eliminate all automatic bias troubles, but what is much more important, we should do away to a large extent with the voltage rise which nearly always occurs when we cut out the heaters of H.F. valves in order to use a gramophone pick-up.

Eliminating Trouble.

With regard to the constructional details of the unit, there is little to be said, and reference will only be made to one or two special points. It will be noticed that the centre points of the two heater windings are picked up artificially by means of two 50-ohm potentiometers P_2 and P_3. If a low value such as this is used, the risk of trouble is greatly lessened. Readers who are using 400-ohm potentiometers across a common heater winding might do worse than try the effect of lowering the value of their potentiometers. Now, although home-grown potentiometers of this type are available, the writer found that it suited his convenience better to make them from two Igranic 50-ohm baseboard resistors. This is done quite easily as follows: One end of the resistance element is connected to a nut and bolt, and this must be left undisturbed. At the other end of the element, however, the nut and bolt also joins up to the connection from the slider. This must be removed and transferred to a separate nut and bolt. Fortunately, the makers have already drilled a hole through the porcelain for us, and all we require is a small 4BA nut and bolt to pass through the hole and secure the slider connection. The job is then complete. Anybody who has one of these components in front of him cannot fail to see how the job is done; it is, in fact, much quicker to do than to describe.



View of the upper side of the baseboard.

Those readers who desire to build the amplifier for battery operation should first of all omit all apparatus which lies on the right-hand side of the dotted line in Fig. 1, as was indicated earlier in this article. The wire

Independent Gramophone Amplifier.—

marked *a* must then be joined to the wire marked *c* and also to a terminal which must be labelled L.T. –. Similarly, *b* and *d* must be joined to an L.T. + terminal. The H.T. – and G.B. + terminals must be connected to L.T. – as usual. The leads from the centre sockets of the two valve-holders, that is, the cathode leads, are simply omitted. The wire that links up R_1, R_2, C_3 and L_1 must be joined to yet another terminal, namely, H.T. +. The centre terminal of the volume control and the G.B. terminal of the L.F. transformer must be connected to wander plugs for biasing purposes.

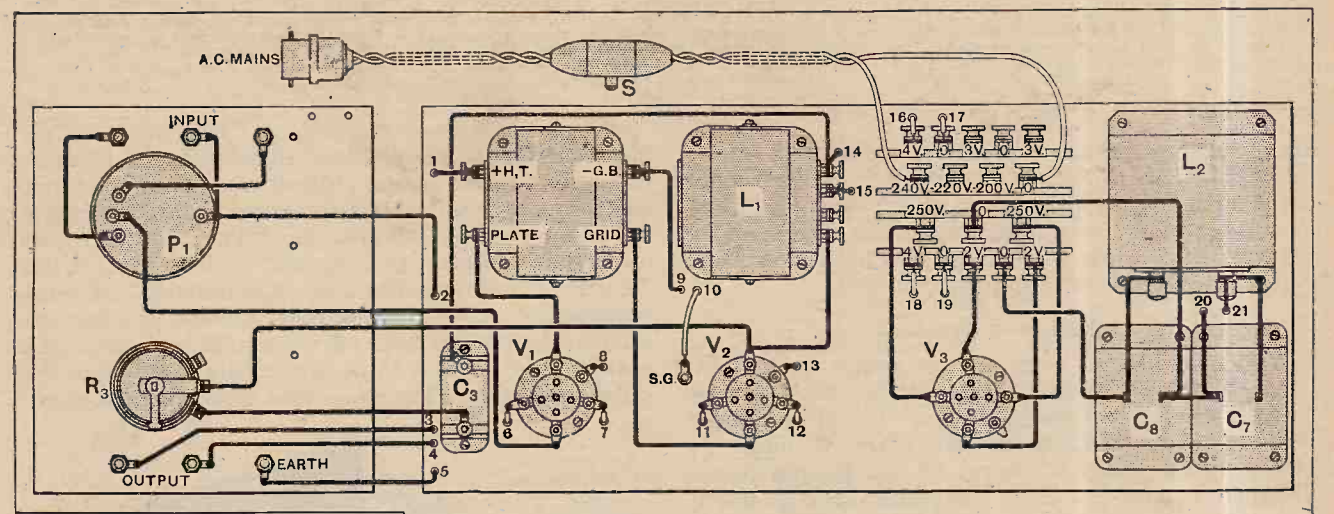
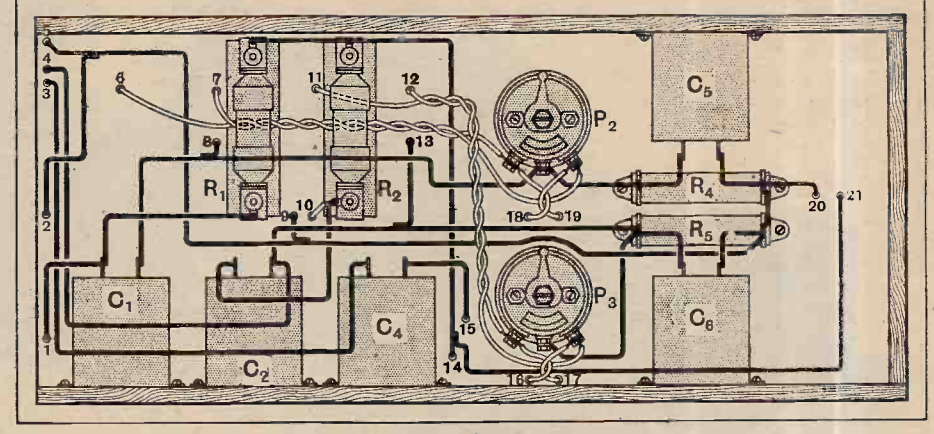


Fig. 2.—The practical wiring plan.



Note that the wires carrying raw A.C. are twisted together.

The use of batteries will considerably restrict our power output, and we shall naturally aim for a pentode valve, since it provides rather more power output for an equivalent voltage input than does a triode, as we have already discovered. A glance at the Valve Data Sheet shows that we can obtain a battery-type pentode which will give us an output of three-quarters of a watt, which will be ample for a room of average size. Those who have D.C. mains having a voltage of not less than about 150 can solve the H.T. battery problem by using an eliminator which can be of a very straightforward type.

Procedure for Modification.

Those who wish to use other valves or to amend the design to suit individual requirements should first determine the output which they desire, and then, irrespective of whether they already possess a pick-up or are about to buy one, should have before them the special pick-up curves published in the March 26th and April 2nd, 1930, issues of this journal, and also the Valve Data Sheet, to which reference has already been made. By careful study of these they will be able to choose their valve, and arrange everything to suit their own particular circumstances so that they will get the output they want without any risk of amplitude distortion or serious frequency distortion occurring.

Alternative Output Valves.

It will be noticed that there is a spare six-volt winding on the power transformer, which is shown in dotted lines in the theoretical diagram. This is not used and it is merely left unconnected. It will be useful to anybody desirous of experimenting with any type of output valve having a filament voltage between 4 and 6. The rectifier valve used by the writer is a U.10.

With regard to the volume control P_1, it should be mentioned that provision is made for the use of two pick-ups so that a "fade" from one to the other may be made if desired. When one pick-up is used connection is made to the centre and to either of the outer terminals.

This amplifier is available for inspection at the offices of "The Wireless World," 116, Fleet Street, London, E.C.4.

WHY NOT ON BRITISH BUSES?

A private omnibus concern in Czecho-Slovakia recently experimented with broadcast receiving apparatus for the benefit of passengers. The idea proved contagious, and each week sees the appearance of more radio-equipped buses.

oooo

DOES WIRELESS CAUSE FIRES?

Scenting a potential danger from fires and explosions due to high-frequency radio transmission, the U.S. Government's liaison committee on aeronautic radio research has recommended that short-wave stations should not be situated near to aircraft fuelling points, writes our Washington correspondent. The committee admits that the precise amount of risk has not yet been determined.

oooo

THE SPANISH LISTENER.

Despite the unsettled condition of the country, listeners in Spain are keeping abreast of modern radio developments. "The Spanish listener will hardly look at anything but an all-mains set," writes a correspondent who has just returned from a visit to Spain." He adds that British apparatus is welcomed, but that the Spaniard prefers to do his own woodwork. Foreign cabinets are subject to import duty.

oooo

A YEAR IN THE ETHER.

The regulation of America's 16,829 amateur radio stations and the examination and licensing of 2,165 new ones are discussed in the annual report of the Radio Division, U.S. Department of Commerce.

With a staff of nine supervisors, 68 inspectors, and 57 clerks, the Division not only attended to amateur radio, "but inspected 11,334 ship radios, measured 45,695 frequencies of wavelengths, built the world's most sensitive radio receiving station at Grand Island, Neb., designing the equipment itself and operating the station to detect interference on all wavelengths used here and abroad, and established nine secondary standards or sub-policemen of the air."

oooo

HIDDEN ADVERTISEMENTS COMPETITION.

The prize-winners in the Hidden Advertisements Competition in our issue of December 10th are as follows:—

1st prize (value £7 10s.): Mr. F. A. Moore, "Maylands," North Western Avenue, Watford; 2nd prize (value £5), Mr. William C. Cox, 19, Queen's Mansions, Brighton Road, S. Croydon; 3rd prize (value £2 10s.), Mr. William J. Gadsby, 57, Croydon Grove, West Croydon, Surrey.

Consolation prizes (each of the value of £1) are awarded to the following: Mr. Robert Käubler (Düsseldorf, Germany), Mr. S. F. Bell (Moortown, Yorks), Mr. P. van den Kwast (Weesp, Holland), Mr. Peter A. Buncle (Dunfermline, N.B.), and Mr. Frederick White (Wolverhampton).

The following is the correct solution:—(1) Mullard Wireless Service Co., Ltd., (2) Bertram Thomas, (3) Players, (4) General Electric Co., Ltd. (Osram Valves), (5) Belling and Lee, Ltd., (6) Ormond Engineering Co., Ltd.

CURRENT TOPICS

Events of the Week in Brief Review.

A REAL TUNING SIGNAL.

Violinists can tune their instruments to the sound of the new interval signal from Brunn, Czecho-Slovakia, which consists of the musical note A.

oooo

THIRTY SHILLINGS PER ANNUM.

The Austrian Government, after hesitating whether to tax wireless sets according to their value, has now decided to institute a flat rate of about 2s. 6d. per month.

oooo

GERMANY DECIDES ON HIGH-POWER PROJECT.

A definite decision to complete the projected scheme of nine high-power broadcasting stations has been taken by the German postal authorities (writes our Berlin correspondent). In addition to the existing stations at Mühlacker and Heilsberg, high-power transmitters are to be installed at Berlin, Hamburg, Breslau, Leipzig, and a site, to be selected, in Bavaria. Langenberg will constitute another link in the chain, which will be completed by increasing the power of the present Frankfurt station.

According to the Prague Plan, Germany possesses twelve wavelengths. Of these nine will be absorbed by the high-power scheme, leaving three for use by such smaller stations as may still be necessary to cover the entire country.

As to when the high-power scheme will be completed it is difficult to forecast. Eleven months is roughly the period assigned for the erection of each high-power station, and the hope is expressed that all nine transmitters will be functioning by the summer of 1932.

oooo

NEW MARCONI COMPANY.

The manufacture and sale of apparatus for recording and measuring marine and submarine signals is the object of the Marconi Sounding Device Company, Limited, which has been registered as a private undertaking with a nonfinal capital of £75,000 in £1 shares.

oooo

RADIO AND THE SCHOOLBOY.

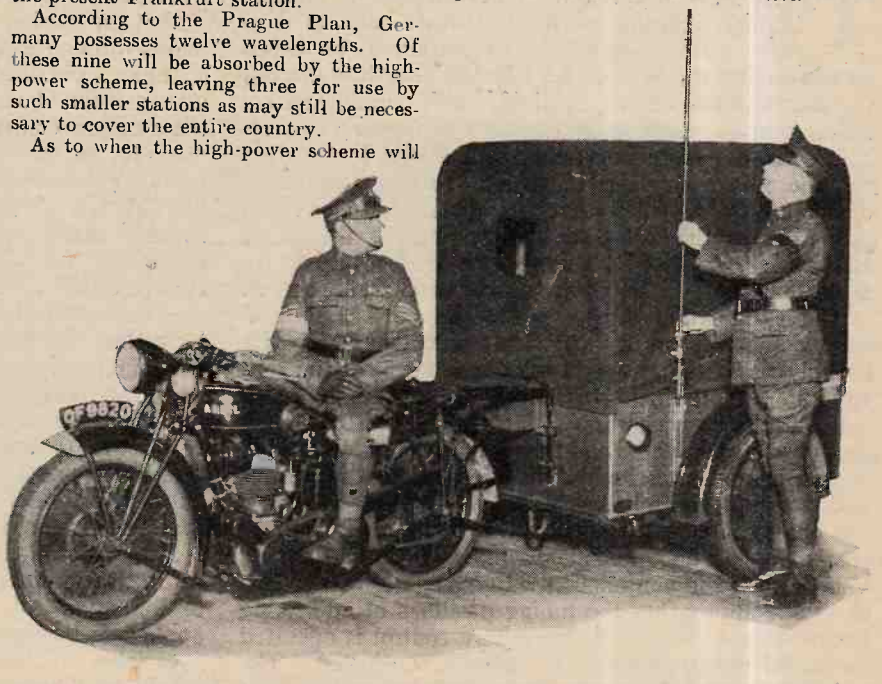
The average boy's interest in wireless will receive due recognition at the Schoolboys' Exhibition, to be held in the Empire Hall, Olympia, from January 1st to 10th, 1931. The Exhibition, which is organised by the *Daily Mail*, will be opened by the Lord Mayor (Sir W. Phené Neal), whose speech will be transmitted to Canada by beam wireless. The Canadian Prime Minister will reply, and his remarks will be heard through loud speakers in the hall.

The Radio Manufacturers' Association will provide a comprehensive exhibit which will include some unusual demonstrations of amplification. The famous "O.B." van of the B.B.C. will also be on view.

oooo

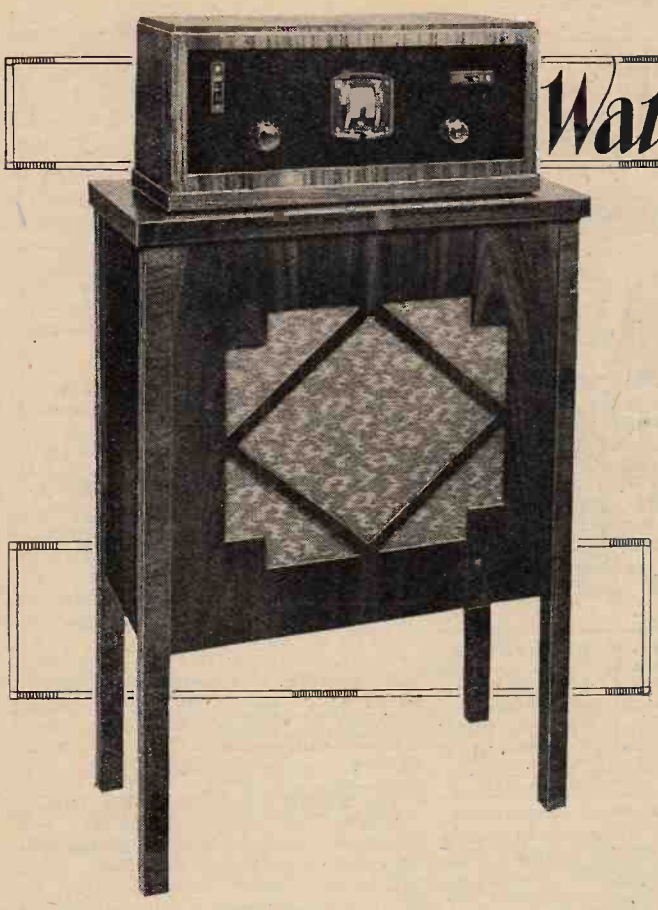
120 KILOWATTS FROM PRAGUE.

When the new transmitter near Böhmisch Brod is ready Prague will have two broadcasting stations. These will be the existing 5-kilowatt station and the new transmitter which will have a power of from 60 to 120 kilowatts.



MOTOR CYCLE WIRELESS UNITS. The 47th (2nd London) Divisional Signals (Territorials) have equipped the first radio transmitting and receiving unit for use with a motor cycle. The trailer, seen in the photograph, carries a crew of two together with a complete radio installation. Messages have been accurately exchanged at distances up to three miles.

Wates All-Electric Four



Comments on Performance with Details of Construction and Circuit.

SPECIFICATION.

Wates's A.C. Mains Four.
A.C. operation from supply voltages of 90/120, 120/130, 145/165, 180/240.
Single H.F. stage, detector and two L.F. stages.
Tuned grid H.F. couplings. Anode bend detector.
Resistance-capacity L.F. couplings.
Two-dial tuning by thumb dials. Tunes to both wave ranges.
Employs reaction. Selectivity control on front of panel

Valves: Mullard D.W.1 rectifier, Mazda AC/SG. H.F., Mazda AC/HL detector and first L.F., Mazda P.425 output. Power output 350 milliwatts.

Price: Receiver £25, including valves and royalty. Complete with double diaphragm loud speaker and loud speaker cabinet £31 6s.

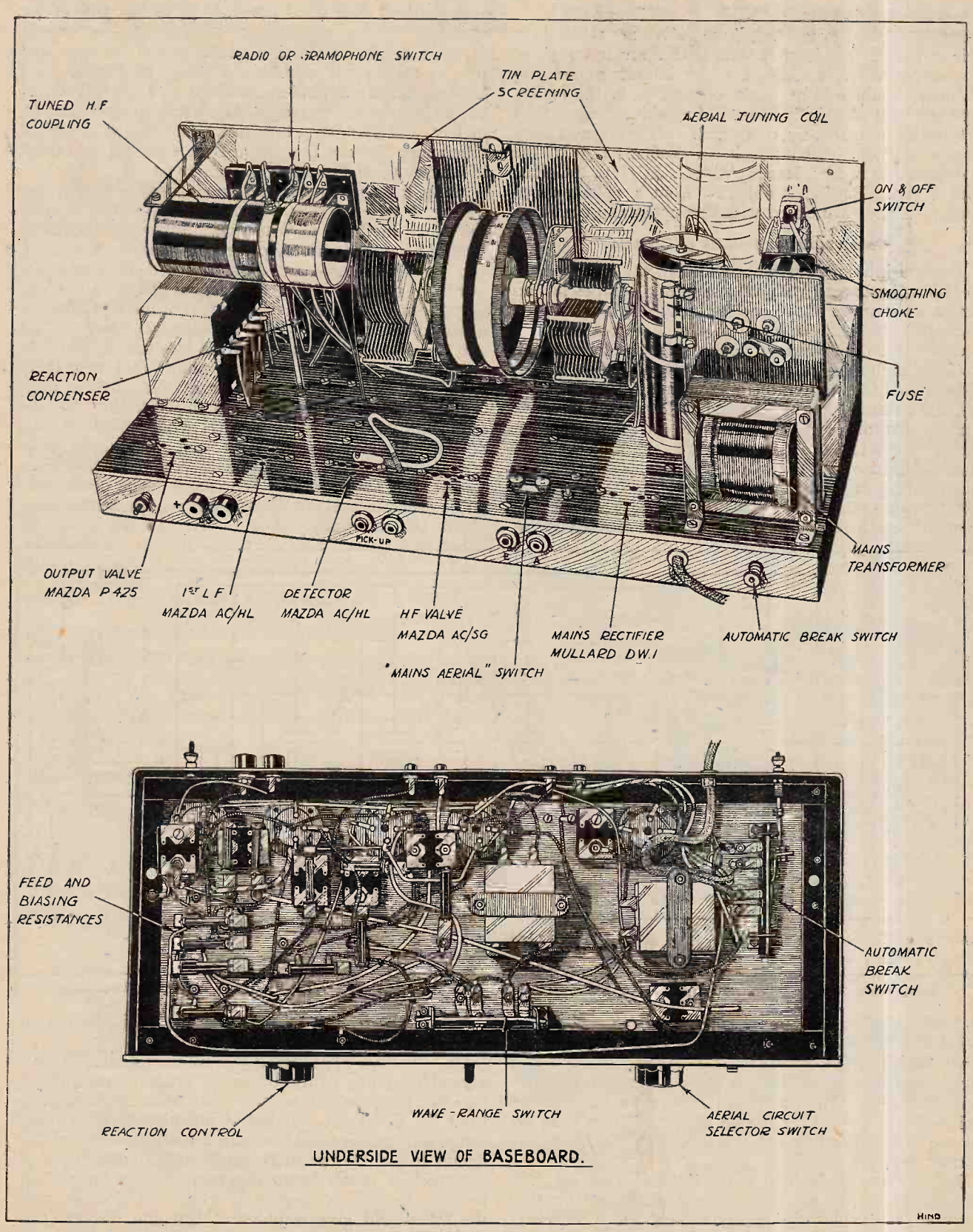
THERE are but few receivers capable of foreign-station reception on the broadcast band in daylight. Rome was the first station to be heard on connecting the Wates' A.C. Mains Four into circuit, the test conditions being daylight, 100ft. aerial, and six miles from the London Regional transmitter. This result is all the more interesting in that the four valves provide only a single H.F. stage. Turning the thumb dials at once revealed that the distant-station-getting properties of this set were outstanding for the single H.F. stage, and all the more remarkable bearing in mind that the detector is the anode bend arrangement.

The explanation of this good performance is that the reaction control is particularly smooth and gives a steadily rising signal over a wide movement of the control knob before finally breaking into oscillation. Critical control of regeneration is further assisted by the fitting of a tapped aerial inductance. This entirely novel feature compensates for differences in aerial dimensions and provides control of selectivity. Such a control is not only desirable to regulate the selectivity as necessitated by location, but allows the sharpness of tuning to be adjusted in conjunction with change of wavelength or as one approaches the tuning positions of interfering transmissions. When the selectivity control is operated the aerial tuning needs to be slightly readjusted. The selectivity control switch has eight positions which, after advancing over the six tappings of an aerial primary coil, next connects the grid to the aerial through a small-capacity condenser and finally connects the aerial directly to the grid. Operation of the selectivity control serves to remove the local station, which breaks through near the zero end of the tuning scale when switched in to the long-wave band.

In this last position the set can be used as a local-station receiver employing but a few feet of indoor wire. Provision is made for entirely dispensing with the aerial in that the closing of a switch connects the aerial to the mains through a suitable condenser. Full loud speaker strength is obtained from the London Regional with this arrangement of using the mains for an aerial and with the reaction control set at zero. It is necessary, incidentally, to set the selectivity switch so that the feed condenser from the mains runs straight to the top of the tuned grid circuit. In consequence, tuning of the aerial transformer is unnecessary, and the single-dial control of the tuned inter-valve coupling suffices to change over between the two London transmissions.

A symmetrical layout of the front panel is obtained by setting up the two thumb-operated tuning dials in an escutcheon at the centre which carries also the short- and long-wave change-over switch, balancing the selectivity and reaction controls and the "on" and "off" switch with the radio to gramophone change-over switch. The front panel is of polished bakelite resembling a polished figured wood surface. It is worth while noting that holes in the panel are eyeleted to avoid fraying.

Pursuing the circuit beyond the H.F. valve we find a tuned grid intervalve coupling and a resistance feed to the anode of the screen-grid valve. Reaction is applied to the tuned grid coupling and is controlled by a variable condenser. Resistance coupling follows the anode bend detector and the first L.F. valve is again resistance-coupled to the output valve. Owing to the inclusion of anode resistances of high value the anode



WATES ALL-ELECTRIC FOUR.—Back and underside views of the chassis.

Wates All-Electric Four.—

voltages applied to the first three valves are rather low. Direct feed to the loud speaker in the anode circuit of the output valve is adopted, which is quite a safe proceeding, as there is no direct connection to the mains, and the loud speaker is housed in a cabinet beneath the set and is permanently connected. With the exception of the rectifying valve, which is a Mullard D.W.1, the valves are in order: Mazda AC/SG, AC/HL, AC/HL, and P.425. Biasing is obtained from a voltage-dropping resistance associated with the smoothing circuit.

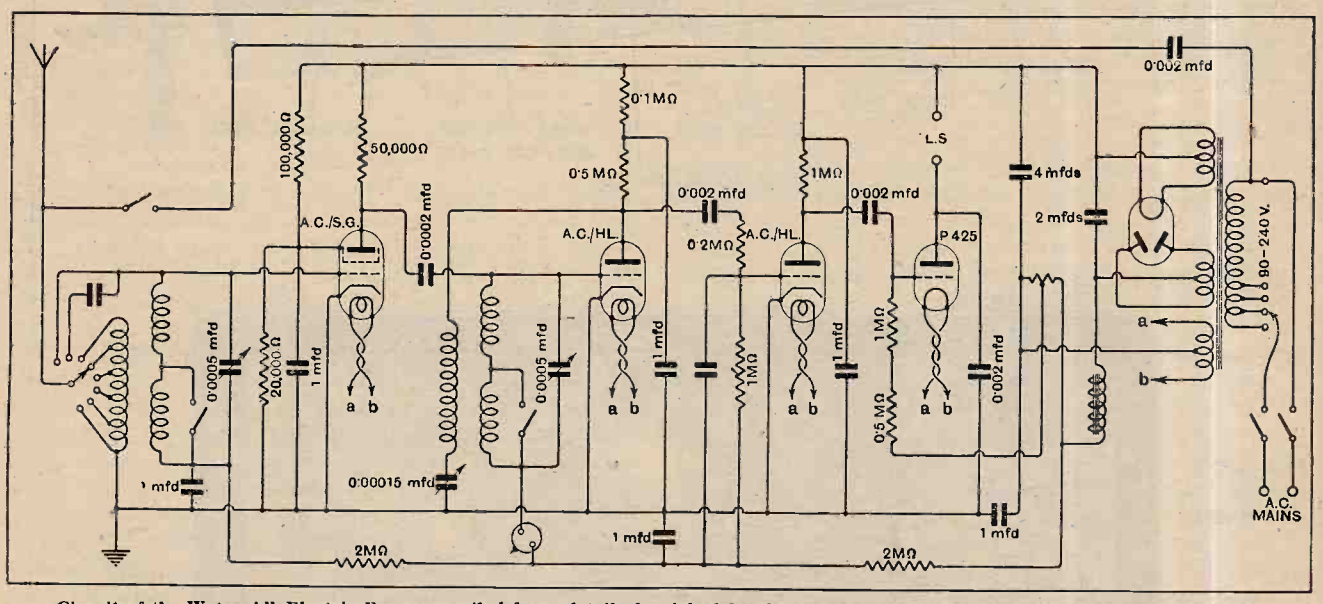
Constructional Details of Chassis.

General interior construction follows the arrangement of hollow baseboard with valves, tuning equipment and mains transformer above and feed resistances and wiring beneath. Bakelite is used for the baseboard and is secured to an iron frame. Bakelised tube formers are used for the tuning coils. Comparatively fine enamelled wire is used for winding the long-wave coils, and though 5XX, Daventry, is well received in London, long-wave tuning calls for careful adjustment of the dials. Tuning condensers of robust construction are secured to the front panel and are operated by metal thumb dials. Both the mains transformer and the smoothing choke appear to be of meagre dimensions, yet this does not mar the performance of the set, and neither is there excessive temperature rise on the transformer. We must bear in mind that it is easier to build a set lavishly than to know just where and to what extent one may economise. The mains transformer appears to be well made and adequately insulated, four tapping points on the transformer primary suit the set for use on mains voltages from 90 to 240. An interchangeable fuse is fitted to the transformer primary.

Easy access is obtained to the interior of the set, but as soon as one of the back screws is released for this purpose a double-pole spring switch slides forward, breaking both sides of the mains circuit. Sliding-bar switches are used in this mains circuit as well as for changing over to gramophone pick-up and for change of wave range. From the circuit it will be seen that the set makes use of nearly a dozen resistances, and these are all of the spiral composition type much favoured on the Continent. Screening is very little used, and is, in fact, not required, this being one of the principal differences between this single H.F. stage set and those in which two H.F. stages are employed.

Many listeners favour the anode bend detector, believing it to give better quality of reproduction than the other methods of detection. Likewise, the same class of listener invariably prefers all-resistance coupling, and the Wates' All-mains Four has both these requirements. Critical listeners well acquainted with modern set performance voted their approval of the reproduction obtained with this set. With the selective tuned circuits and the all-resistance couplings it was anticipated that reception would lack the high notes, and that there would be a predominance of base. No adverse criticism can, however, be made in this direction, the results being singularly "bright," while the bass was satisfactorily maintained. Tests with a modulated oscillator, however, revealed that the highest audio-frequency passed is of the order of 1,800 cycles. The power output is generous and ample for home requirements, being about 350 milliwatts. The receiver measures $19 \times 8\frac{1}{2} \times 8$, and the overall height when the set is carried on its loud speaker cabinet is 42in.

Of attractive appearance this all-mains set will give a good rendering of the broadcast programmes, including the reception of several alternative transmissions from the Continent. It is not intended to be a long-range set, as this would require a rearrangement of the circuit to include two H.F. stages and a costly form of construction involving total screening. As far as can be seen, there is nothing likely to get out of order, and the set should give trouble-free listening, though one year's free servicing is provided by a guarantee.

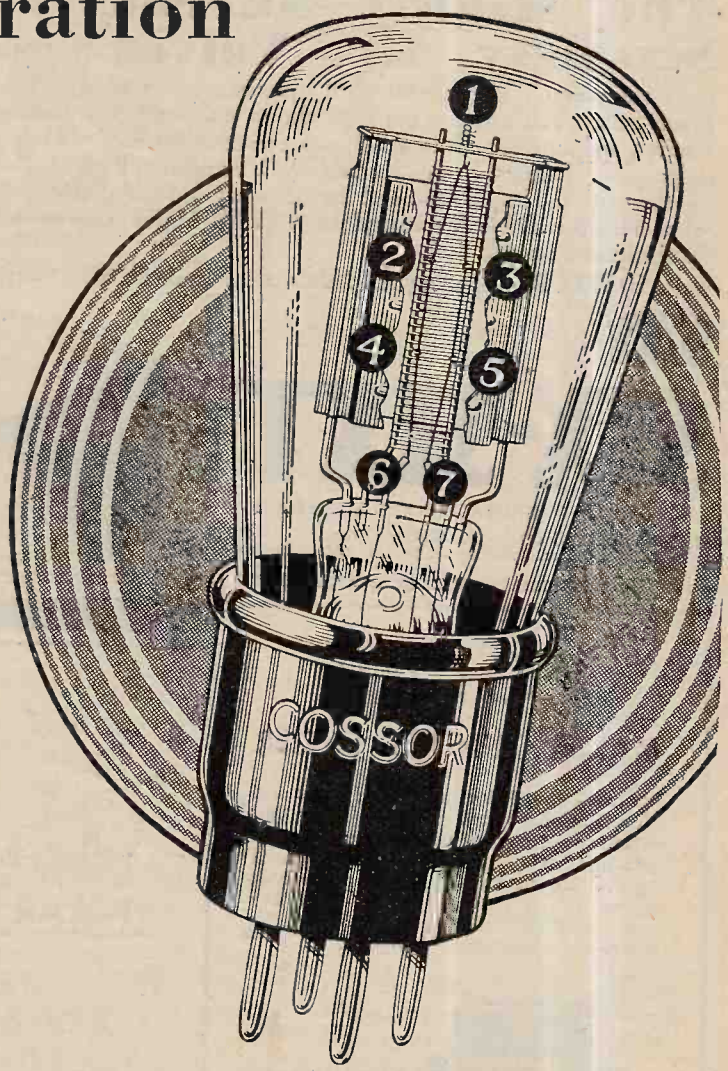


Circuit of the Wates All-Electric Four, compiled from details furnished by the manufacturers (The Standard Battery Company).

Seven point suspension *definitely prevents* filament vibration

—the primary cause of microphonic noises

The cause of microphonic noises in a Receiving Set is generally to be found in a faulty Detector Valve. Usually it is due to filament vibration. The new Cossor Detector Valve (210 Det.) has been specially designed to overcome this fault. Filament vibration is rendered impossible by a new method of seven point suspension. The diagram shows the four insulated hooks which secure the filament in position and damp out any tendency to vibration. The use of this "steep slope" Cossor Detector Valve not only eliminates microphonic noises, but ensures great volume with exceptional purity of tone.



The New Cossor 210 DET., 2 volts, ·1 amp. Impedance 13,000. Amplification Factor 15. Mutual Conductance 1·15 m.a./v. Normal working Anode Voltage 90-150. *Price* **8/6**

We have just issued a novel circular Station Chart, which gives identification details of nearly 50 stations, with space for entering your own dial readings. Ask your dealer for a copy, price 2d. or send 2d. stamp to us and head your letter "Station Chart W.W."

THE NEW COSSOR DETECTOR

DEFINITELY FREE FROM MICROPHONIC NOISES

A. C. Cossor Ltd., Highbury Grove, London, N.5. 7067.

B13 *Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.*

The Power Unit that Supplies those extra volts.

SAY SIX-SIXTY FOR 200 VOLTS H.T. Automatic Grid Bias too, safeguarding your valves. Replaces existing batteries in a moment—takes no more room. Price £6. 6. 0. An L.T. winding (5 amps at 4 volts A.C.) enables you to use the unit at any time with A.C. Valves for All-Mains operation.

The Highly Successful Six-Sixty A.C. Valves

give added range and power. They are standard replacements, and ideal for A.C. Mains Sets. You can now use them also in practically any **battery** receiver, and modernise it to All-Mains operation without altering a single wire. Selected Sets of Six-Sixty A.C. Valves to suit your circuit, together with the Power Unit and the necessary 5/4 pin Valveholder Adaptors, are available as a **complete A.C. All-Mains Conversion Equipment** from £8. 5. 0.

Write for FREE Booklet giving full details of the whole Six-Sixty range.

SAY SIX-SIXTY

(B.V.A. RADIO VALVES AND EQUIPMENT)

SIX-SIXTY RADIO CO., LTD., Six-Sixty House, 17/18, Rathbone Place, Oxford Street, London, W.1. *Tel:* Museum 6116/7.

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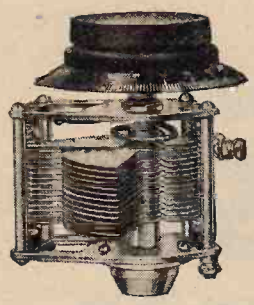
MAKES TUNING EASIER

because—the Polar method of Fast and Slow Motion control gives you direct and definite control over your condenser, with no noisy gears. The reduction movement runs on ball-bearings and the main shaft is suspended on ball races at either end, resulting in an action which is marvellously smooth yet precise.



The "Ideal"

Reduction movement enclosed and fully protected. One-hole panel mounting. Robustly built throughout of chemically cleaned, hard brass.

·0003 - 12/-
·00035 - 12/3
·0005 - 12/6

Phosphor Bronze Balls 6d. extra.

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THE PERFECT CONDENSER FOR EVERY PURPOSE.

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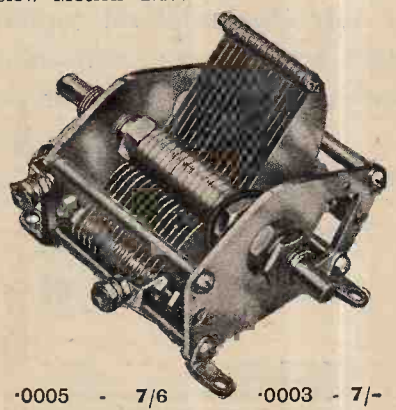
POLAR "UNIVERSAL"

A Condenser specially designed for ganging. Fitted with detachable spindle (various lengths supplied). Baseboard mounting lugs ensure rigidity and accurate alignment. Locked rotor vanes. Suitable for mounting to any type of Slow Motion drive.



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Phosphor Bronze Balls, 3d. extra.

Wingrove & Rogers, Ltd., 188-189 Strand, London, W.C.2; Polar Works, Old Swan, Liverpool.

Unbiased

By FREE GRID.

Too Much "Volume."

OF late years the practice of labelling a reaction control knob with the word "volume" has become more and more prevalent. Personally, I always resent this, and have the feeling that I am being wilfully deceived. It is unfortunately only too true that in the case of many sets professing to embody a real "he-man" H.F. stage only a whisper is to be heard unless the so-called volume control knob is drastically used, and it appears to me that such a case is analogous to labelling the accelerator of a car with the word "brake."

When the accelerator is labelled "brake."

In any case, this practice wrongly gives to the non-technical public the idea that the set in question has a super-abundance of reserve energy, whereas obviously the reverse is the case; moreover, one cannot even make a reasonably smooth alteration in volume by this knob alone, as even in the best of designs variation of the reaction control alters tuning, and consequently the change from full volume to a whisper is very abrupt if we use this knob alone and do not trouble to retune slightly.

oooo

Another Grouse.

If I were asked what were the two things which had done the most harm to the great game of radio, so far as causing the ordinary citizen to abjure it is concerned, I should unhesitatingly plump for (a) that particularly poisonous type of cheap portable receiver with its passenger H.F. stages for which wild claims in the matter or range used to be made by its perpetrators, and (b) that type of radio gramophone which is woefully under-powered on its radio side.

The type of portable to which I have referred is fortunately almost dead, and has given place to an instrument which is really worth having. The same cannot be said of the radio-gramophone, however, and I could quote quite a number of instances of expensive radio-gramophones which, employing a high-powered speech amplifier, are only capable of receiving a nearby station even on a good outdoor aerial. I consider that in view of the high price asked for most types of radio gramophone one is entitled to expect all of them to be equipped with two good H.F. stages operated by a single dial control; as it is, there are far too many of them depending for their range mainly on the inevitable little black knob controlling reaction, but which is more often than not labelled volume control. One can pay as much as fifty guineas, or even more, for an unsatisfactory article of this type.

oooo

The Radio-Gramophone Mystery.

I often wonder how much longer the great radio public will be content to be mulcted of a sum somewhere in the neighbourhood of £30 for an electric gramophone motor and a pick-up, and yet this sum is an average figure representing the difference in price of a high-class radio receiver of the console type with and without the gramophone apparatus mentioned, or, to put it another way, it represents the average difference in price between a high-class radio receiver and a radio gramophone.

Now, as anyone who takes the trouble to examine manufacturers' catalogues can find out, it is possible to obtain the best pick-up and the best electric gramophone which money can buy for a sum which is somewhere in the neighbourhood of £10. Are we to take it that there is £20 worth of extra cabinet work in a radio-gramophone? I have, indeed, actually heard this plea put forward in defence of the high price of the radio-gramophone, but it simply won't wash, as in many cases the cabinet employed for a radio-gramophone is very little more ambitious than the one used to house the radio portion only. I suppose the reason is that the radio-gramophone is still somewhat of a novelty, and is apt to be regarded by the average man as something much more mysterious than a solo gramophone or a solo radio receiver.

oooo

Inventors, Forward!

It has been said by a very well-known figure in the world of radio that a vast fortune is awaiting the man who can discover a method of eliminating atmospherics. This is certainly true, but I think that quite a reasonable sum of money ought to be ear-marked for the man who can give us a really perfect volume control, that is to say, one which will enable us to cut down volume to the desired degree without upsetting either tuning or quality. As it is, most pre-detector volume controls tend to alter the tuning or the selectivity of our receivers, and post-detector controls tend to upset quality, principally in the matter of lopping off high notes to an undesirable degree.

A method of eliminating atmospherics.

Curiously enough, I have found that some of the methods which are most strongly condemned in certain quarters give the best results in practice. This is not due to any error in theory, however, but rather to imperfections in our apparatus.

WIRELESS WORLD

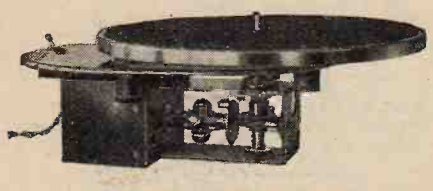
LABORATORY TESTS

A Review of Manufacturers' Recent Products.

B.T.H. GRAMOPHONE MOTOR.

The older pattern B.T.H. gramophone motor employed a belt drive to the turntable with a spring tensioning device. In the new model the drive is through a steel worm pinion and composition worm wheel, which ensures a positive and silent drive. The governor, which is mounted on the motor spindle, is of conventional design, and is provided with a speed-regulating device and indicating scale for mounting on the motor board. The turntable is keyed to a friction collar on the vertical spindle in order to prevent damage to the governor should any attempt be made to speed up the turntable by hand.

The motor, which is of the series-wound universal type, is of unusually small dimensions. It is fitted with copper-gauze brushes and runs at 1,200 r.p.m. The field windings are tapped and a three-way

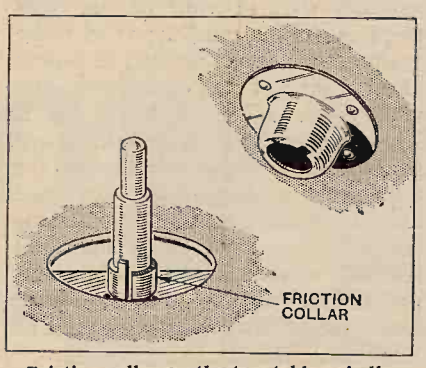


B.T.H. Universal gramophone motor and turntable.

switch provides the following inputs: (1) 100-125 volts A.C., (2) 100-125 D.C. or 200-250 volts A.C., (3) 200-250 volts D.C.

The motor was tested on 210-volt D.C. mains, and the current taken under load was 56 milliamps., i.e., a power consumption of only 11.8 watts. The torque is exceptionally good, and there is no evidence of slowing of the turntable during loud passages on the record. A run of three hours' duration failed to produce any untoward temperature rise or variation of the speed of the motor. Standard frequency records were used to test for variations in speed, and showed an entire absence of cyclic variations in the governor. Mechanical vibration is negligible, and in any case the motor platform is mounted on rubber. The motor was placed within 6in. of the L.F. amplifier and pick-up leads without inducing any commutator noise.

The price of the motor complete with turntable is three guineas, and the makers are the British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.



Friction collar on the turntable spindle of the B.T.H. motor.

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NEW MAGNUM COMPONENTS.

A wire-wound potentiometer available in 5,000, 10,000 and 25,000 ohm., values rated to carry 10 mA., and a 50,000 ohm. size to carry 5 mA., is a recent addition to the Magnum range of components. Contact with the resistance wire is made by a rocking disc operated by a fibre stud on the rotating arm. Thus there should be no appreciable mechanical wear. The measured resistance of a 50,000 ohm. sample was 49,300 ohms. It was perfectly silent in operation. The price is 7s. 6d. in the above sizes, either as a potentiometer or as a variable resistance.

Switches suitable for ganging are in demand for modern sets, and the Magnum version should prove popular. These are arranged for baseboard mounting, and can be operated by rotary action or by a push-pull plunger as desired. They are available in 2-, 3- and 4-way change over, the prices being 3s., 3s. 6d. and 4s. respectively. The plunger mechanism costs 1s. 6d. extra.

A differential reaction condenser with bakelite di-electric and insulated spindle costs 6s. in sizes 0.0001 mfd., 0.0002 mfd. and 0.0003 mfd., each side. A single hole fixing bush is fitted.

The makers are Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1.

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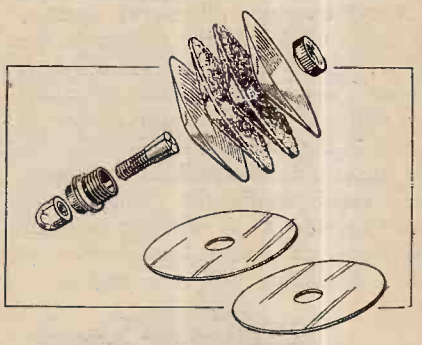
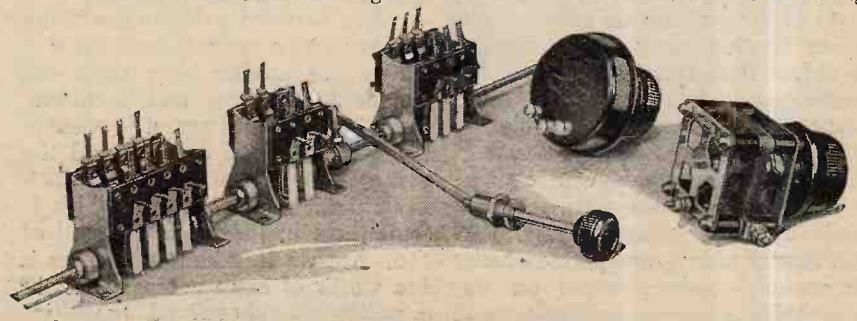
TONAX CONE ADAPTOR.

In the Tonax adaptor, a small felt washer is fitted either side of the diaphragm and between it and the cone-



Tonax cone adaptor with felt fixing washers.

shaped retaining washers. Their function is to assure that the retaining



Groups of Magnum components including ganged switches, a differential condenser and wire-wound potentiometer.

washers contact at all points with the diaphragm, as it is a known fact that where "buzzing" is experienced the trouble can often be traced to badly fitting centre pieces. In addition, two flexible washers are provided as an alternative to the felt ones.

The adaptor is extremely well made, and the price is 1s. Supplies are obtainable from Garratt Stores, 193, Garratt Lane, Wandsworth, London, S.W.18.

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POLAR "TUB" THREE-GANG CONDENSER.

The practice of separately screening condensers and coils in H.F. circuits is rapidly finding favour with set designers in this country, with the result that many manufacturers are turning their attention to the production of screened gang condensers. The latest Polar contribution takes the form of a three-gang assembly with each unit housed in a separate compartment in a die-cast aluminium container.

The moving vanes are mounted on paxolin insulators, the three rotors being electrically one but individually bonded to their respective compartments. The wiring can thus be arranged so that all H.F. paths are separate.

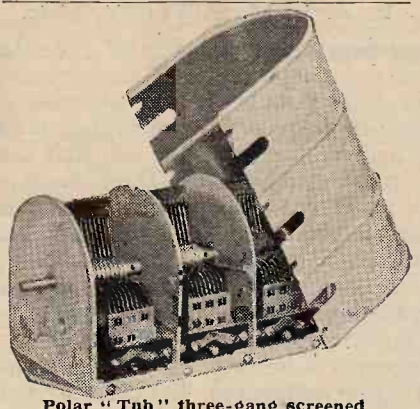
Wide spacing is adopted between vanes and the gauge of the material is stout enough to withstand a reasonable amount of jolting without causing change in the capacity of the condensers. Before leaving the works each unit of the assembly is matched to within 1 micro-microfarad up to 0.0001 mfd. and thence to within 1 per cent. over the remainder of the scale.

The capacity of each condenser in a sample unit was measured at various parts of a 180-degree scale, having first adjusted the trimmers so that the minimum value was the same in each case.

These values are correct to the nearest micro-microfarad, and at some parts of the scale the differences are a fraction of this unit less than indicated by the above figures. The matching can be regarded as entirely satisfactory for most practical purposes.

The price of the condenser is 30s., and with disc drive as illustrated 35s. With drum drive the price is 38s. 6d. The makers are Wingrove and Rogers, Ltd., Arundel Chambers, 188-189, Strand, London, W.C.2.

Scale Divisions.	First Condenser.	Second Condenser.	Third Condenser.
	Micro-mfds.	Micro-mfds.	Micro-mfds.
0	32	32	32
20	62	63	62
40	109	110	109
60	161	162	161
80	214	214	213
100	269	268	268
120	327	326	327
140	385	385	384
160	455	456	454
180	521	523	517



Polar "Tub" three-gang screened condenser with disc drive.

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IGRANIC L.F. CHOKES AND MIDGET TRANSFORMERS.

Some samples of the new range of "constant inductance" L.F. chokes and a midget L.F. transformer have been sent in for test. The smallest of the chokes is styled the "Midget," which has a bimetal core and is rated to carry 15 mA. while maintaining an inductance of 20 henrys. Its measured values with various amounts of D.C. flowing were found to be as follows :—

Type.	D.C. in mA.	Super-imposed A.C. in mA.	Inductance in Henrys.
Igranic Midget L.F. choke, Type C.15.	0	1.13	29.0
	5	1.14	28.9
	10	1.16	28.3
	15	1.3	26.2

This is enclosed in a neat bakelite case and the approximate weight is 6½oz. The D.C. resistance was found to be 930 ohms. The price is 10s. 6d.

The other sample tested was the C.30, which is wound on a normal iron core, rated to carry 30 mA., and has a normal inductance of 20 henrys. The measured D.C. resistance of the winding was found to be 500 ohms, and its inductance measured at 50 cycles with various amounts of D.C. flowing, came out as follows :—

Type.	D.C. in mA.	Super-imposed A.C. in mA.	Inductance in Henrys.
Igranic L.F. choke, Type C.30.	0	1.13	29.0
	5	1.17	28.5
	10	1.22	27.6
	15	1.27	26.7
	20	1.32	25.5
	25	1.35	24.7
	30	1.40	23.6

Although the inductance does not maintain the same constancy as exhibited by the smaller model, it is well above the nominal value over the working range. The price of this model is 15s. 6d.

The Midget transformer is housed in the same style case as the small choke and weighs but 6½oz. It embodies a bimetal core and gives a step-up ratio of 3 : 1. Its main feature of interest is the extraordinarily high primary inductance with little or no D.C. flowing. Measurements made at 50 cycles showed that with no D.C. an inductance of about 124 henrys could be obtained. The A.C. component being 0.22 mA., with 1.0 mA. of D.C. flowing, the inductance dropped to 72 henrys, and with 2 mA. it was down to 47 henrys. The transformer will give the best all-round results when used in a parallel-feed circuit which deflects the steady anode current from the transformer. The price of this model is 10s. 6d., and the makers are the Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4.

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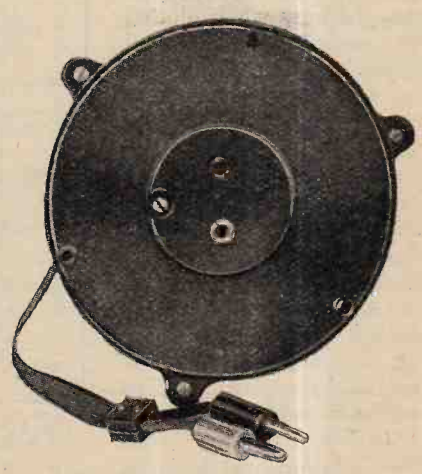
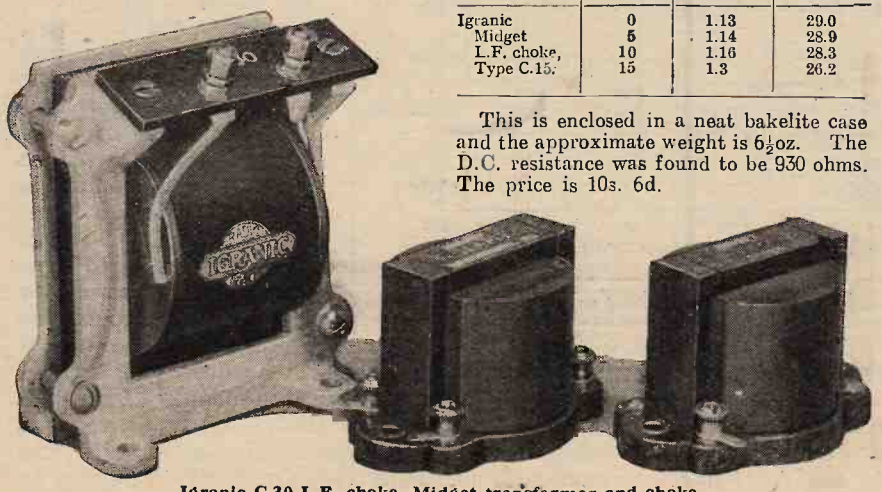
A NEAT LOUD SPEAKER EXTENSION.



The "Cortina" flexible loud speaker extension illustrated above is 32ft. in length, and can be wound when not in use into a moulded case only 4½in. in diameter. The price is 10s. 6d., and the distributors are Messrs. A. Brodersen, 11, Northampton Square, London, E.C.1.



Igranic C 30 L.F. choke, Midget transformer and choke.

The Intermediate Frequency Amplifier of the Superheterodyne

The Relative Merits of Different Frequencies.

By A. L. M. SOWERBY, M.Sc.

(*Concluded from page 692 of issue dated December 17th.*)

IN the preceding articles of this series it has throughout been assumed that the intermediate-frequency amplifier will be tuned to a wavelength very much longer than that of the signal being received. Although it is usual for the superheterodyne receiver to be arranged in this way, owing to the greater ease with which high amplification and good selectivity can be obtained at the longer wavelengths, one or two "freak" receivers have been designed in which the intermediate frequency has been quite differently chosen. A superheterodyne in which the intermediate frequency is below, or not far removed from, the original signal frequency offers some rather fascinating possibilities, but can play some rather unexpected pranks upon an unwary designer.

The writer has found that the best method for tracing out the reasons for peculiar behaviour in the superheterodyne is to draw out curves showing the frequency to which the oscillator has to be set to give the required beat-frequency with received stations of various wavelengths. These curves, if drawn in terms of frequency, come out as straight lines when plotted on ordinary squared paper, so that a diagram for any intermediate frequency of which one desires to investigate the possibilities can be drawn out in a few moments. Several such diagrams are reproduced with this article, but as it is much easier to think in terms of wavelengths than in terms of frequency an approximate scale of wavelengths has been added in each case.

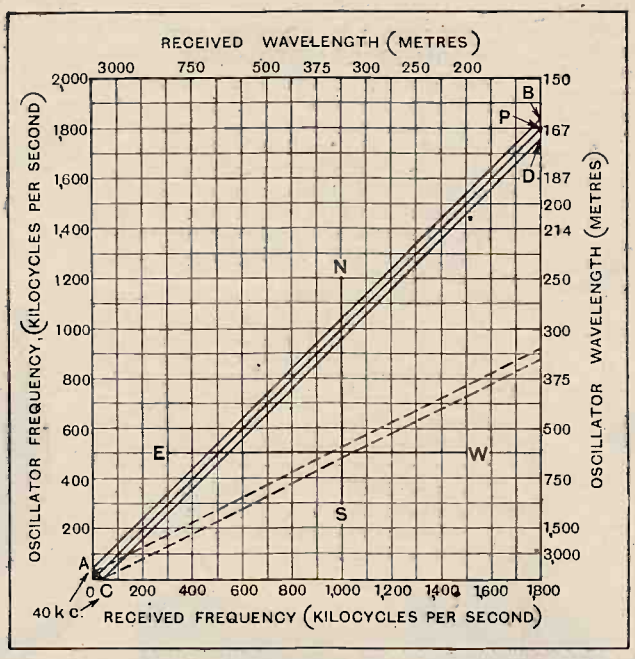


Fig. 1.—Relationship between received and oscillator frequencies for a superheterodyne using an intermediate frequency of 40 kc.

In Fig. 1 there is shown the relationship between received and oscillator frequencies for a superheterodyne in which the intermediate-frequency amplifier is tuned to 40 kc. (7,500 metres). The straight line OP drawn diagonally across the paper represents the purely imaginary case in which oscillator and received signal have the same wavelength; it is included so that the eye can appreciate more readily the slight difference between the two that is shown by the two lines AB and CD.

These lines are, at all points, separated from the centre line by a frequency-difference of 40 kc.; there are two lines, for the reason that the oscillator frequency may be either 40 kc. above or 40 kc. below that of the received signal. A signal on 1,000 kc. (300 m.), for example, may be tuned in by setting the oscillator either to 960 kc. (312.5 m.) or to 1,040 kc. (288.4 m.), as can be seen from the points at which the two lines AB and CD cut the vertical line NS; similarly, if the oscillator be set to 500 kc. (600 m.) signals on either 540 kc. (555.6 m.) or 460 kc. (652 m.) will be heard, as is shown by the points where the lines AB and CD cut the horizontal line EW.

The two dotted lines, crossing the diagram at a flatter angle, deal with the second harmonic of the oscillator, which is frequently rather prominent. These cut the line EW, which corresponds to an oscillator frequency of 500 kc., at 960 kc. and 1,040 kc. These are the two frequencies removed by 40 kc. from the second harmonic of an oscillator tuned to 500 kc. Thus, the same 500 kc. setting of the oscillator which will enable a 460 kc. or 540 kc. signal to give a beat-note of 40 kc. with its fundamental will also enable 960 kc. and 1,040 kc. stations to give the same beat-note with its second harmonic. Unless the frame aerial tunes sharply enough to separate these stations quite decisively, any or all of the four may turn up on setting the oscillator to 500 kc.

With so low an intermediate frequency as 40 kc., the two pairs of stations tuned in by fundamental and harmonic of the oscillator are always widely separated in wavelength, so that, except for the local station, the harmonics do not matter very greatly; the case may be

The Intermediate Frequency Amplifier of the Superheterodyne.—quite different if a much higher intermediate frequency is chosen.

Before going on to discuss receivers using other intermediate frequencies, it may be as well to point out that though it is a little difficult at first to grasp the whole meaning of such diagrams as that of Fig. 1, they become very easy to handle once one has realised that a horizontal line, such as EW, representing some particular oscillator frequency, cuts one curve for every station it can tune in, while a vertical line, such as NS, representing some particular signal frequency, cuts one curve for every oscillator setting that will tune it in.

One of the commercial receivers operating on an unusual intermediate wavelength is the "Auto-Selector" (Selbst-Wähler) receiver made by Messrs. Kramolin and Co., of Berlin.[1] For this instrument an intermediate frequency of 460 kc. (650 m.) has been chosen; as the signal range is 200 to 600 and 700 to 3,000 metres it is clear that while the lower wavelengths are treated in much the same way as in any ordinary superheterodyne, the longer wavelengths are reduced, before amplification, to a wavelength shorter than the original.

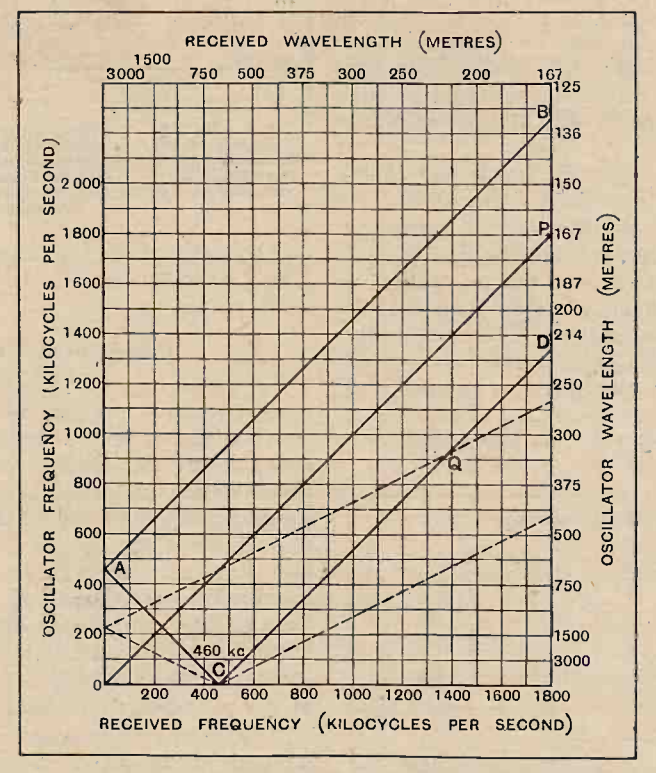


Fig. 2.—Relationship between received and oscillator frequencies for a superheterodyne using an intermediate frequency of 460 kc. (Kramolin.)

The Second Harmonic

How this is done is shown in Fig. 2, which gives curves on the same lines as those of Fig. 1, but calculated for a 460-kc. intermediate frequency. The three parallel lines OP, AB and CD correspond exactly with the same lines on Fig. 1, the last two giving the two oscillator settings that are 460 kc. above and below the signal frequency. In addition to these, a new line AC, which was too small to notice in Fig. 1, has risen into prominence. This shows the settings required to provide that the *sum*, instead of the difference, of oscillator and signal frequencies shall be 460 kc. Each of these three lines, of course, has its dotted "ghost" representing the second harmonic.

Still comparing Figs. 1 and 2, it will be noticed that in the latter, owing to the higher intermediate frequency, the distance of the lines AB and CD from the central line is much greater, with the result that there are no longer two neighbouring oscillator settings for each station, as in the receiver corresponding to Fig. 1. Moreover, if we decide to use only the oscillator setting which is higher in frequency than the signal (line AB) the wave-range through which the oscillator has to be tuned is very much less than in Fig. 1. By tuning the oscillator from 1,960 kc. to 560 kc. (153 to 536 metres) the whole range of signals from 200 metres to 3,000 metres can be covered. It would even be possible, by making deliberate use of the second harmonic of the oscillator, to cover the signal-range mentioned by tuning the oscillator only from 980 kc. to 560 kc. (306 to 536 metres). The oscillator would then be tuned through this range to cover stations from 1,500 kc. to 500 kc. (200 to 600 metres), when the second harmonic of the oscillator would beat with the signal to give the 460 kc. beat-note, and then, for receiving stations from 430 to 100 kc. (700 to 3,000 metres), the oscillator would be tuned again through the same range that had already served for the shorter-wave signals, with the difference that this time the fundamental frequency of the oscillator would be setting up the required 460 kc. beat. For changing from one range to the other the oscillator would remain untouched, the frame aerial being changed (or loaded) to suit the wavelengths to be received.

Interference.

The only difficulty likely to be encountered in putting this scheme into practice is symbolised on the diagram of Fig. 2 by the point Q, where one of the dotted "harmonic lines" crosses the "fundamental line," CD. At this point both the second harmonic and the fundamental frequency of the oscillator are removed by 460 kc. from the same incoming signal (1,380 kc., 218 metres), one having a higher and one a lower frequency. Since both harmonic and fundamental tune in the same signal, no difficulty arises at this exact point; but if an attempt is made to receive a signal on a wavelength not at, but near, the point Q, another neighbouring station may cause very serious interference. If, in attempting to receive a station on 1,400 kc., the oscillator were set to 930 kc. (second harmonic, 1,860 kc.), the fundamental frequency of the oscillator would at the same time tune in another station, if there were one, on 1,390 kc. The frame tuning would then be all that stood in the way of serious interference—and, as the stations mentioned are only 10 kc. apart, they would inevitably be heard together.

This particular type of interference can, at worst, occur only at two points in the entire range of wave-

[1] See *The Wireless World*, Sept. 12th, 1928, pp. 307 and 308.

The Intermediate Frequency Amplifier of the Superheterodyne.—lengths, but it will be seen that, as the position of these points depends only on the wavelength to which the intermediate amplifier is tuned, thoughtless choice of this may bring one of the interference points right into the middle of a much-used band of wavelengths. It is only fair to add, however, that, by constantly tuning the oscillator to wavelengths below that of the signal, interference from this cause can be avoided altogether, as can be seen from the fact that the upper line (AB) is nowhere cut by a dotted line.

In the case of the receiver whose curves are shown in Fig. 2, it might be possible, by lowering the intermediate wavelength a little, to bring the point of interference into the region below 200 metres, where it would be harmless, but only at the cost of losing stations round about 600 metres. In all cases the point Q occurs at a signal-frequency three times the intermediate frequency, while at the point where the dotted line cuts AC the signal-frequency is one-third of the intermediate frequency.

We have discussed a receiver in which the intermediate frequency is lower than that of any station to be received, and one in which the intermediate frequency lies in the gap between the two wavebands that the set is expected to cover. There remains the possibility of making the intermediate frequency higher than that of any station within the tuning range. This possibility has been exploited in America in a receiver known as the "Infradyne,"[2] in which all signals were converted to a frequency of 3,158 kc. (95 metres) for subsequent amplification. So far as the writer can see, there is little point in choosing so short a wavelength as this if it is not intended to receive wavelengths between 100 and 200 metres. Fig. 3 has, therefore, been drawn up on the basis of an intermediate frequency of 1,600 kc. (187.5 metres) instead, and will serve to illustrate the same points.

[2] H. Green, *Radio News*, 1926, Vol. 8, pp. 356 and 357.

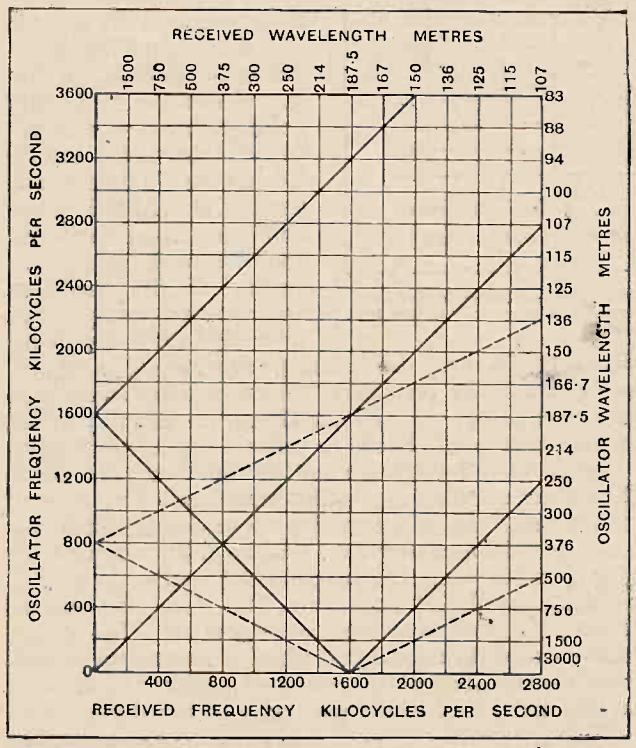


Fig. 3.—Relationship between received and oscillator frequencies for a superheterodyne of "Infradyne" type, using an intermediate frequency of 1,600 k.c.

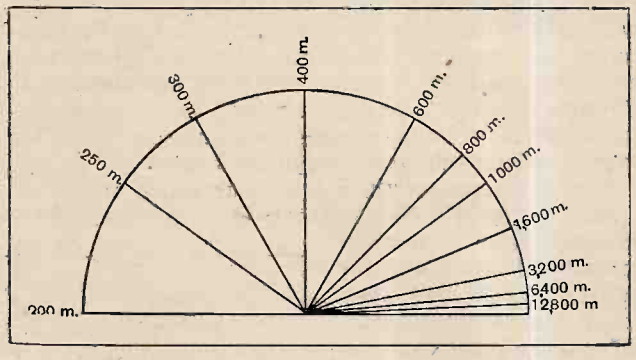


Fig. 4.—How the wavelengths fall on the oscillator tuning dial of a superheterodyne receiver of the "Infradyne" type. The whole tuning range is covered on a single swing of the condenser and the tuning is true "kilocycle tuning." At all points two stations removed by 9 kc. in frequency are separated by a shade over one degree on the dial.

Disadvantages of the Infradyne.

For receiving wavelengths from 200 metres to the longest, we now need an oscillator tuning from 3,100 kc. to 1,600 kc., or 96.7 to 187 metres. This range can very conveniently be covered on a single coil with only a small tuning condenser; moreover, the fact that this range makes use only of oscillator frequencies higher than those of the signals means that one setting of the oscillator can only tune in one station, while oscillator harmonics are completely harmless. Compared with the ordinary superheterodyne receiver, these are very important advantages indeed, and make a receiver built on these lines extremely attractive. Fig. 4 gives an idea of the wavelength calibration of the oscillator dial of any type of "Infradyne" receiver; provided that a straight-line frequency condenser is used, we have true kilocycle tuning over the whole range, which comprises some 1,500 kilocycles. If stations were spaced out evenly, 9 kc. apart, all the way from 200 metres upwards, there would be almost exactly one station per degree over the whole dial. The congestion at the long-wave end is apparent only, for as many stations can be accommodated between 200 m. and 221 m. as between 1,600 m. and 6,400 m.

It will be seen that the use of a wavelength lower than 200 metres for intermediate amplification has in its favour a very long list of advantages—so long a list, in fact, that one is inclined to be very surprised that the long-wave intermediate amplifier, which is, after all, a legacy from the days when the amplification of the shorter waves was not possible, has not been superseded entirely. The drawback which counteracts all these advantages is concerned almost entirely with the matter of the overall selectivity of the set.

For the purpose of discussing the relative selectivity

The Intermediate Frequency Amplifier of the Superheterodyne.—of superheterodynes with different intermediate frequencies, we will make the rather rash assumption that the percentage selectivity of the most efficiently tuned circuit that we can make is independent of the wavelength for which we design it. Although untrue, this assumption is at least near enough to the facts to serve our present purpose. Now, if two stations are 10 kc. apart to begin with, then, after passing through the frequency changer of a superheterodyne, they will yield beat-notes that are still 10 kc. apart, whatever the new frequency may be. But if the new frequency is low—say, 40 kc.—this difference will be a very large percentage indeed of the frequency to which the intermediate amplifier is tuned, so that they will be very effectively separated before they arrive at the second detector. If, on the other hand, the intermediate frequency is, say, 1,600 kc., the 10 kc. difference between the two beat-notes is a very small proportion of the frequency to which the intermediate amplifier is tuned, so that it will fail miserably to separate them, and interference will inevitably result. It follows, therefore, that, to attain a high overall selectivity with a superheterodyne employing a high intermediate frequency ("Infradyne" type), it is necessary to have a very large number of tuned circuits in the intermediate-frequency amplifier, while with a superheterodyne of normal type a very high degree of selectivity is readily attained with two or three tuned circuits at most.

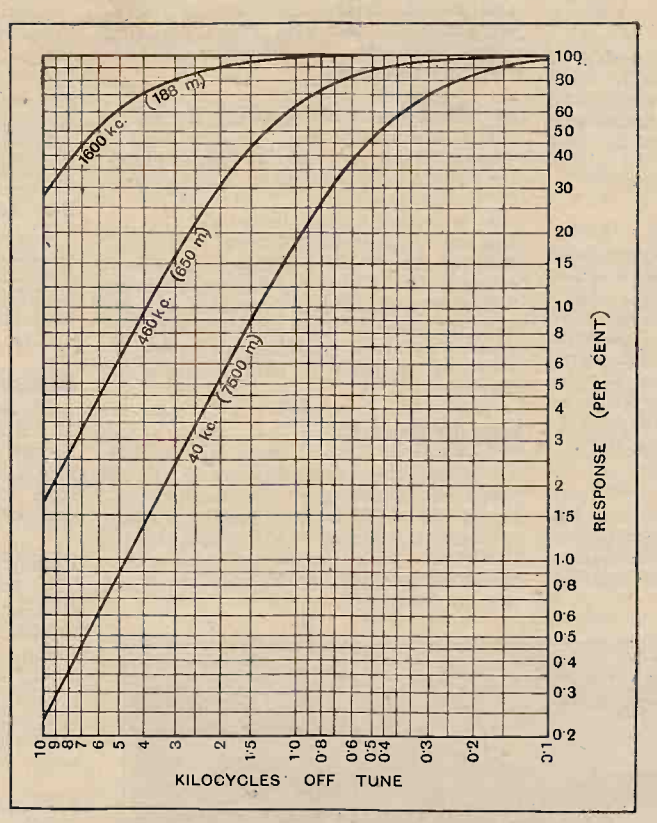


Fig. 5.—Comparative selectivity of intermediate amplifiers working at different frequencies. The very high selectivity associated with the superheterodyne method of reception is due entirely to the use of a very long wave for intermediate amplification.

The point is illustrated by the curves of Fig. 5, which are the resonance curves of two circuits in cascade at three different intermediate frequencies. Here the percentage selectivity is not the same in all cases, the curves having been based on rather more detailed grounds. They give, however, a very clear picture of the great difference in selectivity between different possible intermediate frequencies, and show quite definitely that, unless one is prepared to use a large number of tuned circuits, and possibly to sacrifice some selectivity as well, the very real advantages attached to the use of a high intermediate frequency must be abandoned.

One may put the matter in a nutshell by saying that if one steps up the wavelength in the frequency changer one steps up the selectivity at the same time; but if one steps the wavelength down towards the short waves the selectivity is stepped down with it.

Summary.—This article, and the three others which have preceded it, were written from information gathered and experiments made while settling upon the final design of "*The Wireless World* Band-Pass Superheterodyne." The description already published of that receiver may therefore be taken as a kind of summary, in practical form, of these four more general articles. It is, nevertheless, quite possible that there are readers who prefer to do their own designing, and who would like to have a few outstanding points brought into convenient and pithy prominence.

(1) The superheterodyne can never be economical in valves, for two—the first detector and the oscillator—contribute only a little to amplification.

(2) To set against this extravagance, the superhet. can combine excellent quality and easy manipulation with a degree of selectivity which no other type of set can even approach.

(3) The lower the intermediate frequency, the higher the selectivity, but band-pass filters *must* be used if quality is to be acceptable.

(4) A preliminary H.F. stage cuts out a whole lot of minor difficulties; it also allows a small aerial to be used without fear of radiation from the oscillator.

(5) A screen-grid valve makes the best first detector. Adjust it for anode-bend rectification.

(6) The oscillator should have a series resistance in its H.T. lead rather than a grid-condenser and leak, though either will keep the anode current down to reasonable values. For preference, tune its plate circuit.

(7) Too much amplification at I.F. may raise oscillator-hiss to an objectionable level.

(8) If more than one I.F. stage is to be used, step-up transformers, of ratio not less than three-to-one, should be used for coupling. With tuned anode circuits the amplifier will be unstable.

(9) The second detector must be followed by some kind of filter designed to keep I.F. currents out of the L.F. amplifier. The penalties for omitting this precaution are instability and bad quality.

(10) Do not expect a big signal output from the second detector. Its anode circuit load, for I.F. currents, is almost inevitably high.

BROADCAST BREVITIES

By Our Special Correspondent.

The Courtesy of the Ether.

The B.B.C. is delighted over the courteous behaviour of Mühlacker. The German officials, who are as anxious as any others to preserve peace in the European ether, have reduced modulation, with the result that no complaints are now being received of interference with London's transmissions.

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An Allegation—

The allegation has been made that the B.B.C. engineers should have foreseen trouble when the German high-power plan was first discussed, and have taken steps to prevent disturbance on British wavelengths.

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—And a Reply.

The reply given to me by a B.B.C. official is that the engineers were fully aware of the situation, but were unable to take any measures until transmission had actually started, and interference had been observed.

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Watching Listeners' Interests.

This seems a risky attitude. Fortunately, in the case of Mühlacker we have found a friendly neighbour, but it might have been otherwise. The B.B.C. engineers will be acting in the interests of British listeners if they meet trouble halfway when the question is one of wavelength and power. According to the latest reports, no fewer than seven more high-power stations are to be built to complete the German broadcasting system.

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A Hope.

The new station at Heilsberg, on 276 metres, appears to be far enough distant not to interfere with British listening. May the same be said of the other stations in the chain!

Colonel Brand's Retirement.

An "august presence" will be badly missed by timid visitors to Savoy Hill when Col. H. R. Brand retires in the near future. As official "host" for five years, Col. Brand has imparted the last lingering touch of homeliness to a building which grows more bureaucratic and awe-inspiring each year.

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No "Host" at "Broadcasting House."

His departure is due "to the reorganisation of duties, removing the necessity for a special appointment such as was held by Col. Brand."

I understand that there will be no host at "Broadcasting House." His services at Savoy Hill have been necessary owing to the paucity of studios; in "Broadcasting House" artistes will be able to proceed direct to the studio in which they are to perform, not having to wait, as at present, until a studio is vacant.

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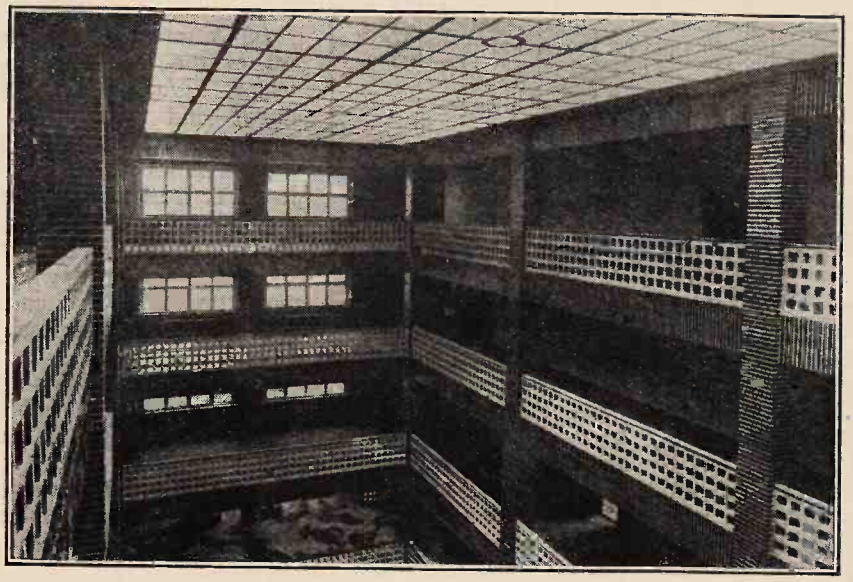
Soothing Remarks.

What often happens nowadays is that an artiste lingers apprehensively in an ante-room, listening to the soothing remarks of the official host, until the critical moment when he or she is rushed into the studio with five seconds to spare. Small wonder that performers are occasionally flurried!



GERMANY'S "BROADCASTING HOUSE." The new headquarters of German broadcasting are shortly to be opened in Berlin. Above is one of the first photographs to reach this country showing the interior. The central light shaft, seen in the picture, is surrounded by galleries communicating with studios and offices.

Broadcasting Murder Trials.

On a dull day last week it was cheering to receive from the American National Broadcasting Company a circular which ran: "The prospect of broadcasting actual murder trials in the not distant future is much brighter than ever before." Mr. Ferdinand Pecora, former chief assistant prosecuting attorney of New York, is reported as saying that such broadcasts would instruct the public "accurately and vividly of the progress of court trials, thus giving wide reports of sincere public interest."

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A Better Idea?

If the N.B.C. really wish to gratify the vanity of murderers and the tastes of crime students it would be better to broadcast actual murders. Sometimes, of course, the "O.B." engineers might arrive too late for the deed itself, but "sincere public interest" could still be catered for by a running commentary on the subsequent execution.

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New Year's Eve.

The closing programme of the year for National listeners will be "Year Out—Year In," a dramatic retrospect. It will include a message from the Archbishop of Canterbury and the Grand Good Night by Mr. J. C. Stobart.

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England *v.* Wales Rugger Broadcast.

A running commentary by Captain H. B. T. Wakelam and Mr. H. B. Brenan on the International Rugby match, England v. Wales, will be relayed from Twickenham in the National programme on January 17.

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Feeling the Public Pulse.

It is one thing to decide that the opinions of listeners shall be respected in planning the programme of Adult Education broadcasts; it is another to discover how to obtain the opinions.

Like every other broadcasting organisation in the world, the B.B.C. is vainly searching for some means of feeling the public pulse.

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A State Census?

Suggestions are numerous, but not one has been found practical. For example, there is the postcard idea. "If you ask listeners to send even a postcard, they won't spend a penny for a stamp," an official told me. "We might provide them with stamped postcards, but probably they would not take the trouble to fill them in and post them.

"We are beginning to feel that the only way to obtain a statistical survey of the likes and dislikes of listeners would be by means of a State census."

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Ideas Wanted.

The census idea sounds good, but it is doubtful whether John Citizen would agree to unbosom his æsthetic self on a buff form. He might do so on a counterfoil to the wireless licence, but . . . well, that's another idea!

Next, please.

CORRESPONDENCE

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

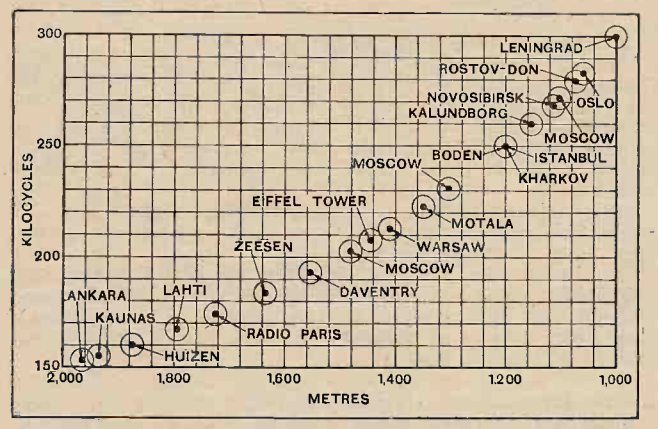
AN ALTERNATIVE LONG-WAVE STATION.

Sir,—I have read with interest the editorial note on the above subject, which appeared in your issue of December 3rd. I think it may be of interest to outline briefly the position with regard to the allocation of long waves for European broadcasting services.

In 1927 the International Radio Telegraph Convention at Washington allotted the following bands of frequencies for broadcasting services :—

160 to 194 k.c/s (1,875 to 1,550 metres) exclusive.
194 to 224 k.c/s (1,550 to 1,340 metres) shared with other services.
545 to 1,500 k.c/s (550 to 200 metres) exclusive.

For our present purpose, however, it is only necessary to consider the so-called long waves, and in this connection the first point of interest is that the use of these wavelengths for broadcasting is a so-called regional agreement which affects Europe only. It is doubtful whether this arrangement will remain in force indefinitely.



The above diagram has been prepared to illustrate the letter from the Chief Engineer of the B.B.C. The positions of most of the principal long-wave stations are indicated with their kilocycle separation. The circles drawn round each station are intended to indicate the spread, the width on either side of the carrier being taken as 5 kc.

At the present time the following nine European broadcasting stations are using wavelengths in the allotted long waveband, i.e., Huizen, Lahti, Radio-Paris, Zeesen, Daventry, Kharkov, Eiffel Tower, Warsaw and Motala. Further, at the conference of Government Administrations and Broadcasting Authorities which took place at Prague in April, 1929, it was agreed that certain existing long-wave stations should be allowed to work outside the band allotted by Washington, provided that no interference was caused to other services using these bands. These stations are Kaunas, Istambul, Kalundborg and Oslo. In addition there are several stations belonging to the Union of the Soviet Socialist Republics using various channels in the long wavebands. Altogether there are at the present time approximately twenty stations working between 150 and 300 k.c/s (2,000 to 1,000 metres).

The value of these long waves for broadcasting is becoming more and more apparent. This is, of course, due to the low attentuation of such waves, particularly when passing over land of a hilly nature. This allows far greater areas to be covered by a single station than is possible when using a "medium" wave, also the range at which intolerable fading sets in is very much greater in the case of these long waves.

The fact remains that there are many countries in Europe not possessing a long wave at all, which, owing to the physical and geographical features, have very great need of such a wave. Strong representations from these countries have been made frequently to the Union Internationale de Radiodiffusion on this question, but so far it has been impossible to satisfy these claims, owing to the fact that there is no space in the long waveband which is not already more than fully occupied.

From the above brief remarks it will be realised that there are considerable difficulties in the way of obtaining another long wave for an alternative service in Britain, although at the present time it would be unwise to attempt to forecast the future.

It seems hardly necessary to mention that the importance and possibilities of these long waves have been very fully realised by the B.B.C. for several years past. In fact, the B.B.C. was one of the first organisations to point out the advantages of these waves for broadcasting purposes.

THE BRITISH BROADCASTING CORPORATION,
N. ASHBRIDGE, Chief Engineer.

RATS.

Sir,—I was interested in the remarks of "Free Grid" upon the preference rats apparently show for A.C. mains, and from his concluding passage regarding the preference of dust for the negative pole I gather that he was not being merely humorous.

A case which occurred in my work some years ago does not agree with the suggestion put forward.

In an underground cable duct having open ends the leads from a 220-volt. single phase alternator were laid together with the leads connecting the field of the D.C. exciter to the voltage regulator, all being of V.I.R. cable.

During the course of a day the circuit breaker opened and it was found that the voltage was over 300, the regulator being out of action.

It was obvious that the exciter field leads were "shorted," and upon examination of the cables it was found that rats had gnawed through these D.C. leads and had left the A.C. leads untouched.

R. ROBERTS.

Four Oaks, Warwickshire.

AN UNUSUAL CRYSTAL SET.

Sir,—The following description of a somewhat unusual crystal receiver may perhaps be of interest to other readers of *The Wireless World*.

This instrument, or, rather, the idea from which it came, was, as usual, the offspring of necessity, in this instance, embodying the following :—

(1) Low first cost.
(2) Little or no maintenance.
(3) Ability to separate the two Brookmans Park transmissions.
(4) Ability to pick up both programmes simultaneously from a single aerial.
(5) Possibility of selecting either programme without alteration to tuning.
(6) Possibility of the two programmes being listened to at the same time by different persons without either experiencing objectionable interference from the other.

Items 1 and 2 obviously indicated a crystal receiver, Item 3 a two-circuit low-loss arrangement, and Items 4, 5. and 6 virtually two complete receivers.

Commencing with the aerial circuit, it was realised that, as the inputs to the aerial due to each transmitter were to be utilised at the same time, this circuit must be of a form in which the possibility of energy leakage to earth, and also energy absorbtion due to large masses of metal work or insulating material, were reduced to a minimum. The series aperiodic arrangement was chosen in preference to that of two parallel tuned aerial circuits for that reason.

The rest of the circuit arrangement—that is. the secondary

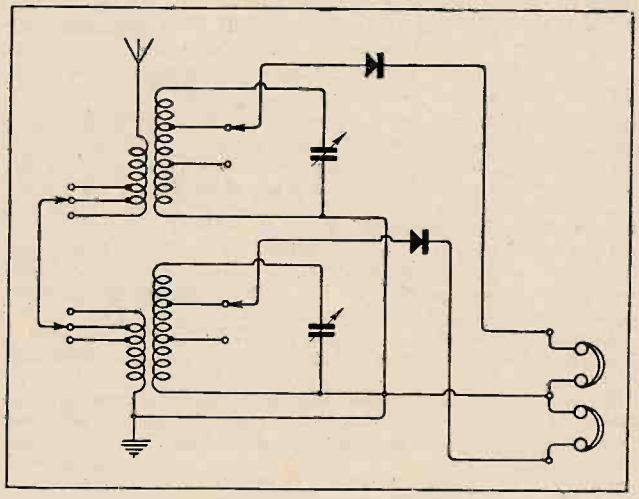
tuning coils and detector-'phone circuits—follow the usual practice and are, in fact, two crystal receivers with their earth connections in parallel.

Before commencing constructional details it may perhaps be as well to say that sharp tuning of the secondary circuits is even more important than usual in this receiver, as otherwise the "National" tuner will take some of the "Regional" energy and vice versa. The secondary tuning condensers also were kept small (in capacity), so that the voltage available for rectification would be as great as possible.

Now for constructional details :—

Each secondary coil is wound on a 3in. diameter by 4in. long paxolin former, the "National" coil consisting of 60 turns of No. 22 S.W.G.D.C.C. copper wire, and the "Regional" coil 50 turns of the same gauge. Taps are brought out in the case of each coil at the 50 per cent. and 60 per cent. positions, counting from the earthed end, and a small terminal provided at the ends of the formers for each termination.

The aerial coils are wound over the earthed ends of the secondary coils, and in the same direction; they each consist of 16 turns of 26 S.W.G. bare tinned copper wire wound over eight "spacer bars" 1½in. long cut from ¼in. diameter ebonite rod and screwed ¼in. B.S.F. thread to provide the winding slots. The wire is wound in every other thread, and taps are made at



the 10th and 13th turns, all terminations being taken out to small terminals as before.

The tuning condensers are housed inside the coil formers, and are of the 0.0002 mfd. Midget variety, a disc, or portion of a disc, of ¼in. thick ebonite being fitted to one end of each former to form a suitable mounting. A knob and dial can be fitted to the condenser spindle in the usual way, but an ebonite knob only is all that is actually required, because once the initial adjustment has been made, no other is necessary, as only one station is to be received on either coil.

Angle brass fixing lugs are fixed to the bottom ends of the formers, so that they can be fastened down to a suitable baseboard.

Since no panel was necessary the two detectors which were of the two crystal semi-permanent pattern, were mounted on a strip of ¼in. thick ebonite of suitable dimensions, as also were the three output or 'phone sockets (Clix).

A cover in the form of a wooden box turned upside down, measuring approximately 9½in. × 9½in. × 6in. deep, hinged to the back edge of the baseboard so that in the closed position only the aerial and earth terminals (mounted on the hinged side of the cover) and the output terminal block mounted near the front edge of the baseboard, and for which a gap was cut in the front side of the cover, were visible.

This receiver is, therefore, eminently suitable for persons not wishing to be bothered with tuning adjustments; in fact, those wishing to receive both transmissions on a crystal as easily as they previously received the one only, especially blind or aged persons, will find initial adjustment is all that is necessary.

Where it is desired to employ an indoor aerial erected in a roof void this receiver can be put there also and lead-covered twin bell-wire or alternatively three wires can be run from it to suitable terminal blocks fitted to various rooms; if the lead-covered wire is used the lead sheath is used as the common earth connection.

In operation it was found that the tuning adjustment of one section did not affect that of the other, and, by making use of the aerial coil tappings provided, good signal strength without objectionable interference was obtainable with different forms of aerial.

H. HAZEL.

VALVES.

Sir,—May I draw the attention of valve makers to certain aspects of their advertisements, particularly those relating to output valves? The average advert. contains the following particulars :—

Filament volts.	Amplification factor.*
,, amps.	Impedance.
Maximum H.T. volts.	Mutual conductance.*

* Taken under purely fictitious conditions.

Of these the amplification factor—in an output valve—is relatively of minor importance, while the mutual conductance probably interests about one listener in a thousand. The three most important items—grid bias and anode consumption at maximum H.T. volts and "maximum undistorted power"—are carefully omitted. Fortunately, *The Wireless World* publishes a valve data sheet, but I suggest manufacturers might be more helpful.

G. M. PART.

Tunbridge Wells.

"WIRELESS FOR THE BLIND" FUND.

Sir,—I should like at this time of the year to bring once again to the notice of your readers the British "Wireless for the Blind" Fund. It will be, of course, remembered that on Christmas Day last year Mr. Winston Churchill launched our appeal for a sufficient sum of money to provide all the necessitious blind of Great Britain and Northern Ireland with a wireless set.

This appeal met with a most gratifying response and the fund has been able to supply over 6,000 crystal sets during the course of the present year.

At a later date a further broadcast appeal was made, and the total amount subscribed during 1930 has reached the sum of £25,000. It has, therefore, been possible to place an order for 5,000 single-valve receivers, delivery of which will commence in January, 1931.

It has been ascertained that there were 20,000 blind persons at the beginning of this year requiring a wireless set. There will thus be still 8,000 people to supply after we have received delivery of the sets above-mentioned.

It is for this purpose that Mr. Winston Churchill has consented to make a further appeal on Christmas Day next with the object of obtaining the balance of the money required, namely, £20,000.

The committee of this fund feels extremely grateful to the listening public who have already so generously subscribed, but feel entitled also to bring this matter to the notice of your readers again as they are still confident that there are many throughout the country who do not yet realise what a boon wireless is to the blind.

> "It is his newspaper, his guide to the throng of humanity, to the sports grounds, to pageants, and, in brief, to all that is interesting."

During the present year there have been several collections made amongst offices, warehouses, and by private individuals in towns and villages, and I personally feel confident that if this were done in many places throughout the country sufficient money would almost immediately be forthcoming. As an instance, may I cite the case of one town in Buckinghamshire where 456 residents collected a sum of over £36.

It is the very keen desire of the fund to complete its work as early as possible in the New Year, and it is therefore hoped that all who read this letter will show their sympathy by forwarding a donation to the Right. Hon. Reginald Mc'Kenna, who is the honorary treasurer to the Fund, 226, Great Portland Street, London, W.1.

CAPTAIN SIR BEACHCROFT TOWSE, Chairman.

226, Great Portland Street, London, W.1.

READERS' PROBLEMS

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Replies to Readers' Questions of General Interest.

Regulating Pentode Screen Voltage.

According to published instructions, a voltage not exceeding 200 should be applied to the auxiliary or screening grid of the AC/PEN valve. In practice this means that a resistance must be inserted in the feed circuit; will you please tell me how to estimate the correct value for this resistance, bearing in mind the fact that I have not access to any current-measuring instruments?

It may be assumed that 3.5 milliamps will be passed in the screening grid circuit of this valve when the maximum voltage of 200 is applied. Taking this figure, and knowing the working voltage of the eliminator output from which the screen is to be fed, the necessary resistance value (in ohms) is ascertained by dividing "surplus volts" (*i.e.*, difference between eliminator voltage output and 200) by 0.00035.

A by-pass condenser of 2 mfds. should be joined between the screen and cathode terminals of the valve.

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Limiting Maximum Volume.

When my receiver is used for the reproduction of gramophone records through a pick-up I find that volume is more than ample when the rotating contact of the controlling potentiometer is set at about the mid-point of its travel round the resistance. Unfortunately, some of the members of my family do not agree with me as to what constitutes reasonable volume, and so, to prevent unnecessary noise and overloading of the valves, I should like to arrange matters in such a way that volume is automatically limited to normal "half strength."

This could obviously be done by fitting a stop for the potentiometer slider, but I should prefer, if possible, to do it without making it obvious that this component had been interfered with. I believe that an extra resistance will serve the purpose; will you please show me how it should be connected?

The maximum volume of gramophone reproduction can be limited to any desired extent by connecting a resistance in series with the controlling potentiometer, as shown in Fig. 1. Unless your present potentiometer happens to have a resistance winding increasing its value logarithmically in relation to the slider rotation, the desired conditions would be attained by arranging for the potentiometer and the resistance R to have similar values.

To avoid the possibility of impairing the pick-up frequency characteristics, it might be necessary that the sum of these two resistances should be made to equal the resistance of the existing potentiometer. But unless the manufacturers of your pick-up issue definite recommendations as to the correct value of shunting resistance, it is probable that this course will be unnecessary; if you adopt it, a new potentiometer will, of course, be required.

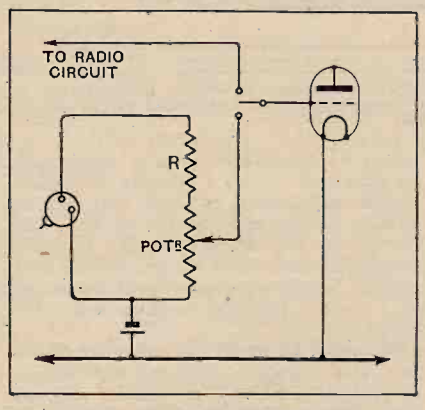

Fig. 1.—By connecting a fixed resistance in series with the controlling potentiometer, the maximum value of gramophone reproduction may be reduced to any desired extent.

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Filter Circuit Adjustments.

It has been suggested that when making initial adjustments to a capacity-coupled filter circuit an abnormally large coupling condenser may be used temporarily in order to avoid the confusing effects of double-humped tuning. Is it not a fact that any change from the normal value of coupling capacity will introduce variations in the tuning of the circuits?

Yes, this is correct, but as regards the two tuned elements of the filter itself the alterations introduced by changes of coupling capacity should be identical, and so if they are tuned by a dual condenser the accuracy of ganging will not be impaired, although the dial setting corresponding to any particular wavelength will be slightly changed. If, however, the receiver includes a tuned H.F. stage (or stages) controlled by the same ganged condenser assembly it will be clear that all the circuits will not be affected to the same extent by a change of coupling condenser, and inaccuracy will arise unless some precautions are taken to compensate for it.

In practice, when it is decided to adopt this method in testing a set with filter circuits, it is as well, while adjustments are being effected, to control the H.F. tuning condensers individually; these may be set correctly when work in connection with the filter itself is finished.

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Matching Coils.

To avoid the need for effecting adjustments after assembly, I intend to make an attempt to match the coils for my new receiver, which is to have single-dial tuning control. I have not access to elaborate testing equipment, but think it should be possible to ensure that inductance values are fairly well matched by joining each coil in turn across the grid circuit of a bottom bend detector with a large anode by-pass condenser to sharpen up tuning by preventing anti-reaction feedback. An anode milliammeter will be used as an indicating device, and care will be taken to see that operating conditions are kept constant; signals from the local station will be used as a source of input voltage.

The weak point about this method of matching seems to be that it does not take into account any differences in self-capacity, and it is conceivable that two coils with considerable variation in their true inductance should appear to be identical. Do you think that this is a sufficiently serious drawback to make the method valueless?

If great pains are taken to avoid errors, we think that by adopting the plan suggested you should be able to match your coils satisfactorily. It is quite true that this method does not take into account any differences in the self-capacity of the windings under test, but if the coils are of a type suitable for use in a ganged receiver and are well made, it is impossible for any serious differences of this kind to exist. We presume that you intend to effect adjustment by the removal or addition of turns where necessary.

Series-Parallel Valve Filaments.

It is intended to build a receiver with six valves, all rated at 2 volts, and having filament current consumptions of 0.1, 0.1, 0.15, 0.15, 0.1, and 0.3 amp. (in that order). My household supply is at 230 volts D.C. Is it possible, by connecting the three 0.1 amp. valves, and also the two 0.15 amp. filaments in parallel, to run these two combinations in series with the 0.3 amp. valve? If so, the current consumption need not exceed 0.3 amp.

Although the method of connection you propose is rather complicated, it is practicable, and we give in Fig. 2 a diagram showing how the various banks of valves should be connected. This arrangement suffers from the unavoidable drawback common to all forms of series-parallel connections, that the failure of one filament in a parallel group will cause a rise of voltage across the others. Further, the anode current taken by the "later" valves in the receiver will pass through the filaments of those at the "negative" end of the chain, but this extra current will probably not be serious, as the output valve which you propose to use will presumably not pass a very heavy anode current.

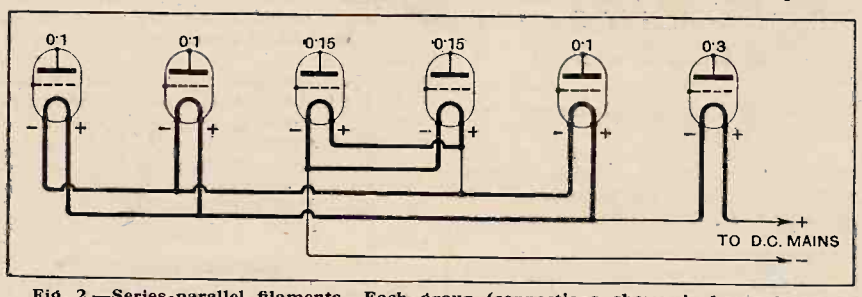

Fig. 2.—Series-parallel filaments. Each group (connections shown in heavy lines) consumes 0.3 amp. Polarity and current consumption of individual valves are indicated.

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Disturbing a Ganged Tuning System.

Do you think that the operation of the ganged tuning condensers of my receiver would be upset if I were to fit a separate aerial circuit, tuned by an external condenser and variably coupled by means of a very small capacity? The set at present has three linked condensers controlled by a single knob; trimming condensers are fitted, and "ganging" seems to be almost perfect.

It is practically inevitable that the addition of a tuned aerial circuit with capacity coupling will change the incidental capacities at present existing across the aerial input circuit, but it is possible that this change can be largely compensated for by adjustment of the existing trimming condenser. It must be remembered, however, that considerable alterations in coupling are likely to bring about the need for a readjustment of the "trimmer" setting.

If care is taken, we think that your proposed alteration should be quite satisfactory, but it is certain that the operation of the modified receiver will call for rather more skill than formerly.

Avoiding Loss of Voltage.

I am thinking of building a set on the lines of the "All D.C. Three" ("The Wireless World," August 20th and 27th), but modifying the design so that power grid rectification may be employed. My D.C. current supply is at 240 volts, and as no loss of voltage can be tolerated in this particular case, I am wondering whether it would not be better to transfer the limiting resistance R_{10} to the positive main lead. A few words of advice would be welcomed.

The special arrangement of resistances in the "All D.C. Three" confers the advantage that voltage distribution will be unaffected by variations of mains voltage between 200 and 240 volts, provided that suitable adjustment of the limiting resistance be made. Consequently the specified values of resistances remain unchanged. In your case, where a sacrifice of voltage cannot be tolerated, it would certainly be wise to change the position of R_{10}; this should be joined between R_9 and the smoothing choke, and the anode feed connection for the detector should be picked up from the junction point between this choke and R_{10}.

It should be made clear that by effecting this change voltage distribution throughout the receiver will be altered, but there will be no need actually to change the values of any of the resistances, although the tapping points on the H.T. potentiometer R_8 must be moved nearer to its positive end.

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How Wave Range may be Restricted.

My H.F.-det.-L.F. receiver has recently been rebuilt, and a number of the original components, including a dual-range H.F. transformer and the tuning condensers, have been used. The wave-range of the intervalve circuit was previously quite adequate; now its behaviour seems to be unchanged so far as the medium wave range is concerned; but its minimum wave-length on the long waves seems to be unduly high. It is now impossible to receive wave-lengths much below 1,100 metres. Can you explain this, and also suggest how the range may be extended?

It is rather hard to see how any alteration can have been made that does not affect the constants of the tuned circuit on both wavebands, and we have come to the conclusion that you must have connected a short-circuiting switch of unduly high capacity across the long-wave transformer secondary. Cases of this sort have come to our notice on several occasions, and the trouble has generally been traced to the use of a switch which is unsuitable for H.F. work. Excessively high capacity is sometimes found to exist in a switch with spring contact blades separated by thin strips of bakelised material.

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Shortcomings of Choke Decoupling.

It seems to me that in designing a receiver with power grid detection loss of voltage in the anode circuit might be largely overcome by employing a choke instead of a resistance for decoupling purposes. An L.F. choke of very high inductance has an ohmic value of about one-tenth that of the resistance customarily used for this purpose; taking a practical case and allowing 6 milliamps to be passed through the decoupling system, it would appear that the loss in one case would be less than 20 volts, and in the other at least 120 volts.

Do you know if this method has ever been tried, and, if so, with what results?

Generally speaking, a choke is not satisfactory as a decoupling device. This is because it offers a comparatively small impedance to low-frequency currents; to make matters worse, the associated by-pass condenser acts as a serious barrier to those same frequencies. Consequently, the object of the decoupling system is largely defeated. It may be added, however, that a choke may be fairly effective for this purpose, if the L.F. amplifier is so arranged that the magnification of low frequencies (of 50 cycles or less) is almost negligible.

FOREIGN BROADCAST GUIDE.

BERGEN

(Norway).

Geographical position: 60° 21′ N. 5° 20′ E.
Approximate air line from London: 647 miles.

Wavelength: 364 m. Frequency: 824 kc. Power: 1.0 kw.

Time: Central European (one hour in advance of G.M.T.).

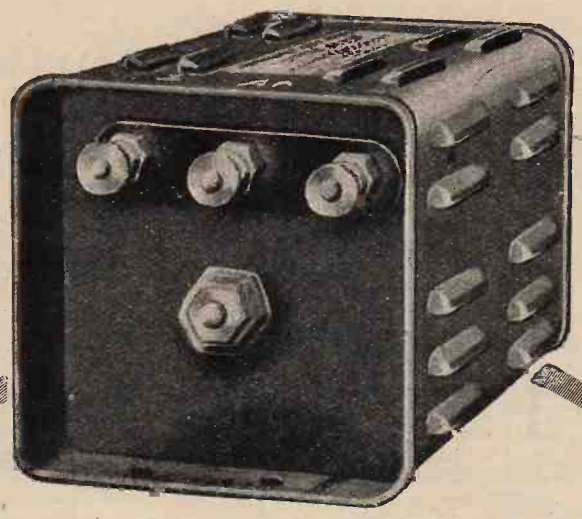
Standard Daily Transmissions.

10.45 G.M.T., gramophone records; 11.30, weather; 19.00, main evening programme; 20.00, weather, news; 21.00, Time signal, concert; relay of foreign stations (Tues. Fri.); dance music (Wed. Sat.).

Frequently relays broadcasts from Oslo.

Male announcer. Call: *Dette er Bergen Kringkaster.* During intervals: *Her Bergen.*

Closes down with a few bars of Norwegian National Anthem (*Ja vi elsker*) followed by *Godnat, Godnat.*



You need this in *your* mains set

If your current supply is A.C., your problem is to obtain a suitable direct current supply—possibly low tension, certainly high tension—and Westinghouse Metal Rectifiers provide a means of converting from one to the other safely, economically, and more perfectly than any other means yet devised.

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W.W.93

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Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

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RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors. — Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

BOWYER-LOWE 7-valve Superhet. with 6-volt valves, gramophone pick-up, £4/10; Philips A.C. eliminator, £2; Ferranti trickle charger, £1; seen by appointment.—9, Aubrey Rd., W.8. [2586

3-VALVE All Electric Receiver, 200-250 volts, A.C., perfect condition; £15. or nearest; seen by appointment, London area.—BM/CCSF. London, W.C.2. [2581

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IMPORTANT NOTICE.

Owing to the Christmas Holidays, the next issue of "THE WIRELESS WORLD" (dated December 31st) is closing for press earlier than usual.

In accordance with the Notice that appeared last week, the latest date upon which Miscellaneous Advertisements could be accepted for the above issue was FIRST POST, MONDAY, December 22nd.

Receivers for Sale.—Contd.

APPLEBY'S, where radio part exchange began.

THE Service is as Follows: We can supply practically all the leading lines of radio apparatus on the market at current list prices; if so desired we can accept in part exchange the reputable makes of the following apparatus: Receivers (domestic and portable), radio-gramophones, loud-speakers (cone and moving coil), cone unit and chassis battery eliminators and mains equipment components, battery chargers, remote control equipment, pick-ups and carrier arms, electric gramophone motors, H.F., L.F., and power chokes, condensers (variable, reaction, by-pass and smoothing), measuring instruments (high grade), L.F. transformers, slow motion dials (high grade), modern miscellaneous components; valves and tuning coils cannot be accepted in part exchange except by special arrangement.

IN View of the Difficulty of Making Fair and Definitely Offers for Material that we have not inspected, it is requested that apparatus tendered for part exchange be kindly forwarded to us for valuation; no business can be proceeded with in connection with part exchange until material tendered has been examined; in this connection there need be no fear; material is sent to us from all over the world; not a single item of customers' property has ever been lost or mislaid; rejected offers from Xmas last amount to only 3.

IN Order to Furnish a Guide, the part exchange allowance may be gauged as approximately 50% of the list price of the article or articles tendered; for some articles the allowance will be more, and for others somewhat less; the allowance is entirely determined by the demand for individual articles, considering also their condition and production age; amateur constructed receivers cannot be accepted in part exchange as receivers, their value lying wholly in the components contained in them; only modern apparatus in good condition is accepted in part exchange; material cannot be purcased by us for cash.

TERMS of Part Exchange Business: A minimum of 50% of the value of an order, plus carriage charge where due, is payable in cash, unless the value is below £1, when a minimum of 10/- is payable; should the part exchange allowance exceed 50% of the total value of new requirements, the difference will be credited against future orders; material may be deposited against a credit note, which may be utilised at a later date; the maximum amount allowed to stand to the credit of any one individual is £200.

APPLEBY'S, Chapel St. St. Marylebone, London (opposite Edgware Rd., Metropolitan Station, or 4 minutes from Marble Arch, Oxford St.). Tel.: Paddington 8828 (3 lines). [0340

1930 5-valve Receiver, 5-watt output, 400v. eliminator, all in cabinet; cost about £80, accept £20.—Broadfoot, Roselea, Hoylake, Cheshire. [2556

£4/10.—Screened grid 3, volume control, choke output, finest components possible, unused.—30, Newton St., Bensham, Gateshead. [2585

PHILIPS 3-valve, 240 volts. A.C., type 2514, perfect; £15.—26. Branston Rd., Harlesden, N.W.10. [2584

GECOPHONE Victor 3-valve Receiver; £6/17/6, for £3.—"Whincroft," Market Av., Chichester. [2578

"WIRELESS WORLD" Four.—We are busy on this fine set, and our experience is at your disposal. May we build yours?—E.C. Wireless, Premier Place, High St., Putney, S.W.15. [2576

"WIRELESS WORLD'S" Marvellous Short Valve S.G. Pentode Three, valves, batteries, 20-100 metre coils, fitted milliammeter; removal sacrifice, month old; cost over £16, lowest £11.—8, Blue Hall Mansions, Hammersmith, W.6. [2569

3-VALVE Solodyne, incorporating wave-trap and output filter, complete with valves and batteries and mounted in 3ft. oak pedestal cabinet, Blue Spot baffle speaker and small Hegra speaker included; exceptional bargain, the lot £10.—3a, Fourth Av., Queen's Park, W.10. [2598

IGRANIC Superhet., large open type, with high frequency stage, about 250 metres to 4,000, very fine condition; to clear at £5.—Michael Lavin, Old House, Sonning, Reading. [2597

OFFERS Wanted for the Following: 4-valve screened grid receiver, with output filter choke, in handsome walnut cabinet, 24×13¼×12½in.

OSRAM Music Magnet Four (assembled), less valves.

BLUE Spot 66R Loud-speaker Unit and Chassis.

McMICHAEL Radio Filter; turntable for portable receiver; all the above as new.—Box 8454, c/o *The Wireless World.* [2596

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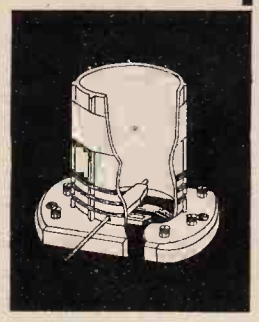
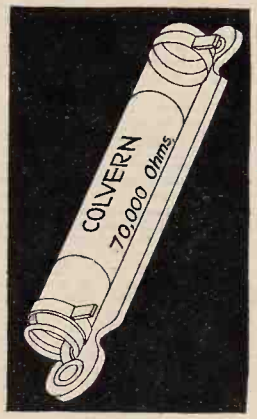
FOR THE 'WIRELESS WORLD FOUR' BATTERY SET . .



4 T.G.B. Coils, 9/6 each.
4 Screens, Type CCS, 3/6 each.



1	Colverstat 20,000 ohms	2/6
1	Colverstat 20,000 ohms, centre tapped	3/6
1	Colverstat 40,000 ohms " "	3/6
1	Colverstat 25,000 ohms	2/6
1	Colverstat 15,000 ohms, tapped 5,000 ohms	3/6
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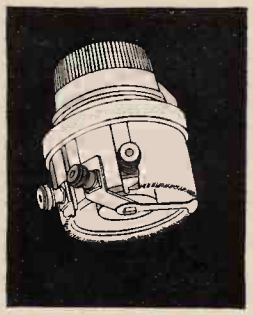
1	Colverstat 1,500 ohms	2/6



2 Variable Colverstats, 50,000 ohms, 5/6 each.
1 Double Pole Switch type S.2. 2/3.

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Advt. of Colvern Ltd., Mawneys Rd., Romford.

SEND FOR THE COLVERN BOOKLET.

Receivers for Sale.—Contd.

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

SILVER Marshall All Electric 8-valve, 110 A.C., with valves; £14.—Guest, 42, Shoot-up Hill, N.W.2. [2573

MARCONI 44, 2 S.G., splendid instrument, nearly new, with valves; sacrifice, 8 guineas.—Hextall, 95, Long Lane, Finchley. [2600

BURNDEPT S.G. Three, pentode output, complete with Mullard valves, leather covered metal cabinet, condition as new, little used; £7.—3, Belfield Rd., Didsbury. [2606

"WIRELESS WORLD" A.C.3, 200-240v., with Ferranti milliammeter and oak cabinet; £12; after 6 o'clock.—25, Queen's Gardens, Ealing, W.5. [2604

KING 5-valve Neutrodyne English Valve Holders and Long Waves; £5/10; demonstrated pleasure.—Thomas, 299, Upper St., Islington, N.1. [2567

A MAGNIFICENT Set.—The National Regional Three, absolutely complete, including Tungsram valves, 2-volt accumulator, 100v. H.T. battery, Ormond cone speaker, fully guaranteed, wonderful value; £4, inclusive; carriage paid.—H. Panagakis, A.M.I.R.E., wireless specialist, 91, Dale St., Liverpool. Bank 8756. [2618

3-VOLT Receiver, mahogany cabinet, Exide L.T., 220v. A.C. eliminator, Ediswan speaker, £6; also complete parts for "W.W." Europa portable, 2 S.G. valves, pentode and cabinet, £4.—Bryant, 2, South Ridgway Place, Wimbledon. [2614

AMAZING Wireless Offer.—Genuine Lotus screen grid and pentode receivers, magnificent mahogany cabinets, including 3 Osram valves, value 51/-; usual price £12/10, bargain price £6/10; carriage paid; guaranteed brand new, perfect and unused; sent c.o.d. if desired.—H. Panagakis, A.M.I.R.E., Wireless Specialist, 91, Dale St, Liverpool. Bank 8756. [2619

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PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

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H.T. Eliminator Kit, incorporating Westinghouse H.T.5 rectifier, kits consist of transformer, choke, Westinghouse rectifier; required condensers, resistance, safety plugs and sockets, and baseboard; output 20 milliamps at 120 volts, 47/6, post free; metal case for same, 3/9 extra.

ELIMINATOR Kits, transformers, choke, condensers, valve, valve holder, resistance, terminals; 36/-; post free.—Fel-Ectric Radio, Garden St., Sheffield. [2049

VORTEXION Transformers and Chokes, wound to specification; best quality components only supplied.

VORTEXION No. 4 Bobbins, 1in.×1½in., 1/3, post 2d.; 1in.×1in., 1/-, post 2d.; cast aluminium end plates, 2/3 per pair, post 2d.; No. 4 laminations for 1½in. bobbins, 6/2, post 9d.; for 1in. bobbins, 4/2, post 6d.

VORTEXION, 72, Merton Rd., Wimbledon, S.W.19. Tel.: Wimbledon 2814. [0439

SOUND SALES.—Genuine British Stalloy Stampings.

NO. 30 for "Wireless World" choke, 1½in. core, 4/6, post free; 1in. core, 3/6, post free.

NO. 4 Stalloy Stampings, 1½in. core, 6/-, post free; 1in. core, 4/2.

CLAMPS and Bolts for Above, 1/6 and 2/-.

WE Can Supply Any Wire, bobbin, terminal strips, etc., c.o.d.

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WE Guarantee All Transformers Undergo a 4-hour Test on Overload; for insulation, correct voltage and freedom from buzzing, the safety factor is ample for all requirements.

SOUND SALES, Tremlett Grove, Highgate. 'Phone: Archway 3871. [2492

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Coil Screens - - 3/- each.
Valve Screens - - 2/9 each.
(with special ventilation holes and insulated top.)

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W.W.I.

Chargers and Eliminators.—Contd.

EKCO 3F20 A.C. Eliminator, as new; £2/10.—Johnson, 25, Clivedon Rd., E. 4. [2599

TANTALUM for A.C. Rectifiers; blue prints for inexpensive H.T. and L.T. chargers.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [1209

H.T. Transformer, Rich and Bundy, 100 or 200v. input, 475v. at 100 milliamps, 7.5 volts at 3 amps., £2/10; also R. and B. 200-volt input, 150v. at 50 milliamps, 4v. at 1½ amps. 20/-; also 100 or 200v. charging transformer, 12-volt at 1 amp., 10/-.—Thomas, 299, Upper St., Islington, N.1. [2566

BRYCE'S.—Mains transformers are guaranteed for good regulation and efficiency and included in all sets and eliminators of repute, manufacturers of all mains sets supplied; type A.B.4, output 300-0-300v., 80 m.a., 2.5-0-2.5v., 1.6 a., 2-0-2v, 3 a., 2-0-2v., 0.275 a.; price 22/6 postage 1/-; write now for price lists.—Bryce's, 54, Dawson St., Bury, Lancs. [2607

SPECIAL Offer. — Thermattaix; thermo-electric couples, electrically or gas operated, complete with voltmeter, ready instant use, to clear about 300, output 0.05 to 1 ampere, 2, 4 or 6 volts; sale price 20/- to 40/-, normal price 70/- to 200/-; terms cash with order or c.o.d.—The Grosvenor Supply Co., Ltd., 12, Grosvenor Gardens, S.W.1. [2615

CABINETS.

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CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [1479

KAY'S Cabinets.—Exclusive practical models in radio and radiogram cabinets, 50% cheaper than elsewhere, used and recommended by the most distinguished and discriminating radio experts; a range of 60 designs to select from; illustrated price lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Walthamstow 1626. [1789

CRAFTEASE Cabinets, for wireless sets and gramophones, ready to assemble or assembled; lists free.—Craftease Works, J. Mendip Industries, Winscombe. [2412

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 495, Cambridge Rd., London, E.2. [9706

BAND Pass Three Coils, 30/- set, "Wireless World" specification; slotted formers for winding, 8/6 set; grooved primary supports, 2/- set; all D.C. Three formers, 8/- set; decoupling resistances, 1/6 each; all post free.—Groves Brothers, Coil Manufacturers, St. Mary's Place, Shrewsbury. [2269

MAINS Transformers to Supply 3- or 4-valve Sets, 25/-; chokes, 15/-; these transformers give guaranteed outputs, 200v. 60 m.a. on load, quality second to none; traders and wholesalers, you need these.—Write Eric Cookson and Co., 14, Cambridge Rd., Blackpool. [2529

LEWCOS Dual Binocular Coils, one D.B.A., two D.B.P., ganged, and single switches; the 3 17/6.—Dewhurst, Beulah St., Harrogate. [2587

BERCLIF Coils, the finest made, for all receivers; get our list (post free) before buying, trade supplied.—Simmonds Bros., 38, Rathbone Lane, Smethwick. [2620

BAND Pass Super Heterodyne, coils, 27/6 set; boxes and screens, 12/6 set.

WIRELESS WORLD Four, Foreign Listener's Four, coils, boxes and transformers; best and cheapest; trade supplied; send for lists.—Townhead Radio, Duke St., Rochdale. [2609

DYNAMOS, ETC.

E.M.I Motor Generator Set, 230v., 50 cycles, single phase, direct coupled to 2 generators, output of one 400v., 200 m.a., output of other 8v. 7 amps., unused; cost £31, what offers?—Apply Armstrong, 55, Brown St., Manchester. [2591

M-L Rotary Transformer, input 220-240v. D.C., output 400 volts 150 mA., recently passed perfect by M-L; bargain, £7 or near offer.—Newman, 100, Claremont Rd., E.7. [2612

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Battery Model

WITH A

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EPOCH.—If you have not, take the first opportunity of doing so.

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EPOCH.—No matter what loud-speaker you have heard, your decision will be firm.

EPOCH.—You will not hesitate, you will not ask your friend, you will not ask an expert.

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EPOCH.—The Domino destroys all previous standards of comparison.

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"YOUR 101 Domino Moving Coil Speaker Duly Received, and has now had 5 weeks' use, and my conclusion is that it is the only loud-speaker on the present market.

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EPOCH.—"Gentlemen,

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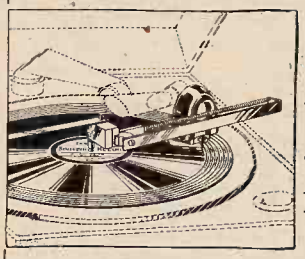

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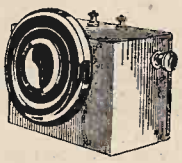

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FOR A.C. MAINS

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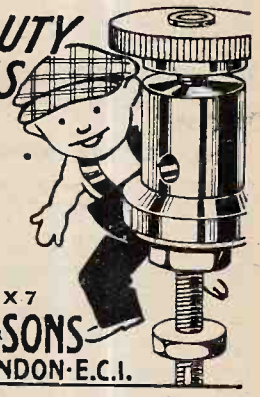

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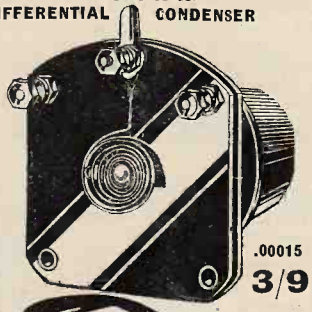

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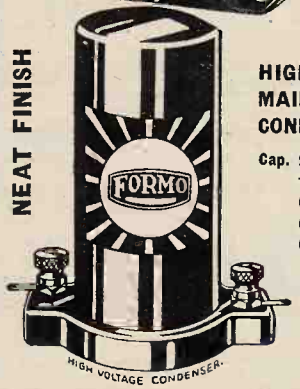

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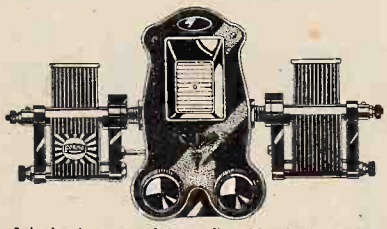

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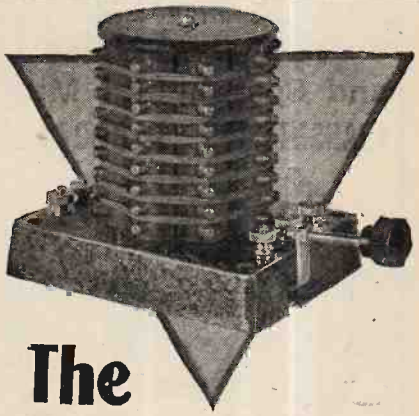

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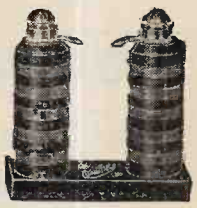

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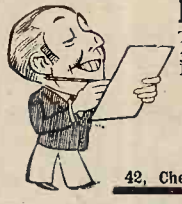

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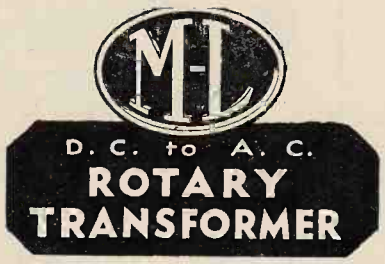

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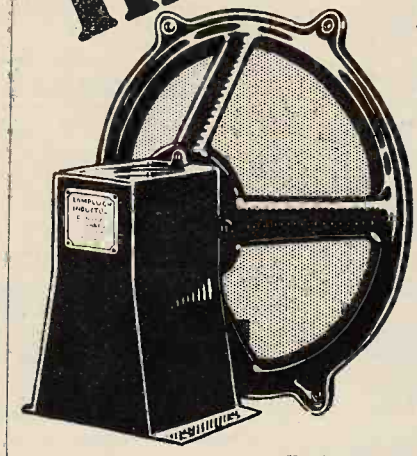

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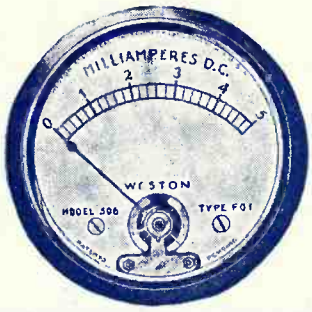

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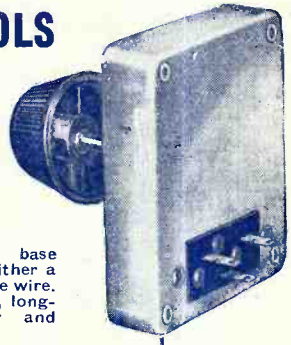

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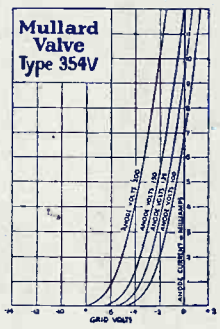

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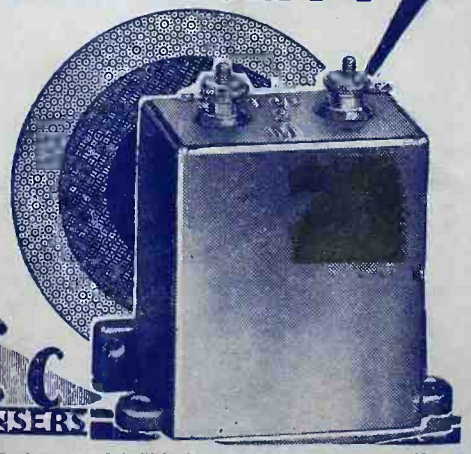

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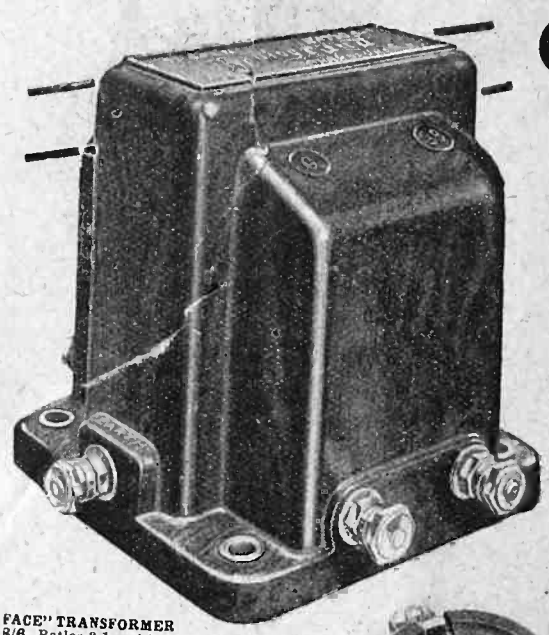

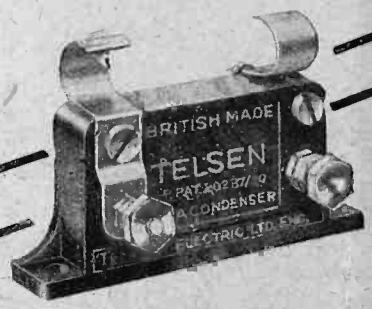

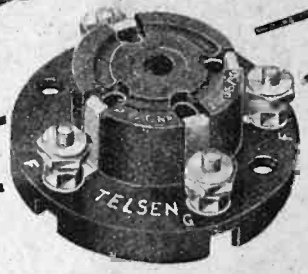

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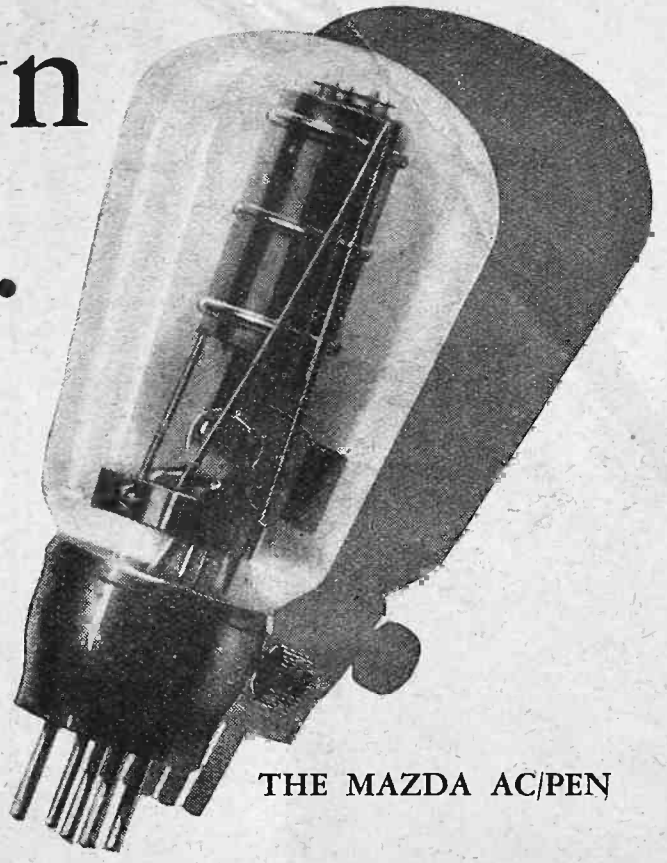

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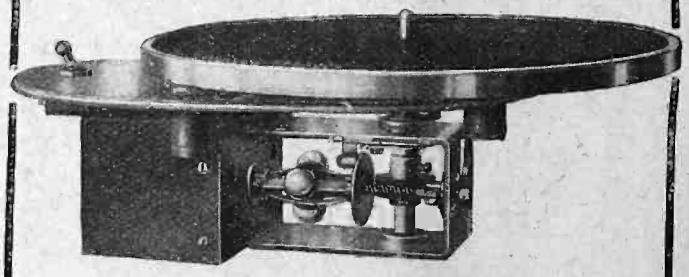

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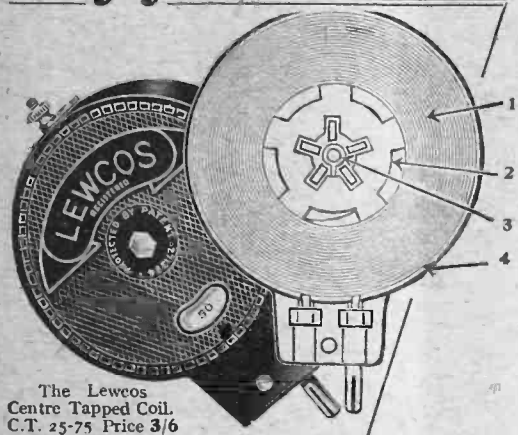

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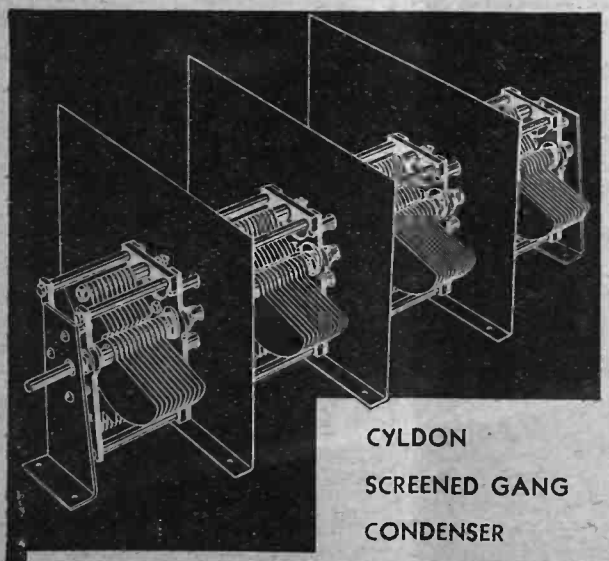

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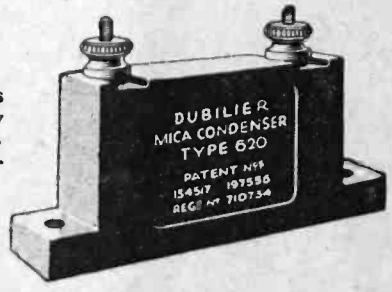

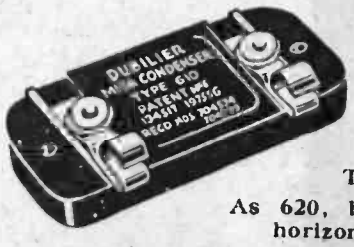

TYPE 610

As 620, but arranged for horizontal mounting.

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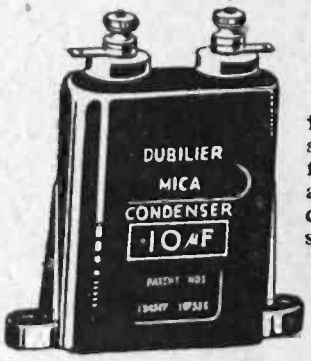

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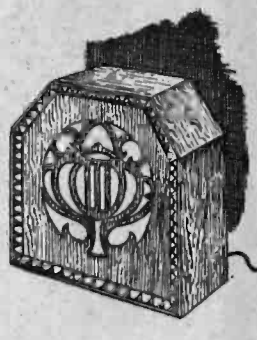

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AND RADIO REVIEW
(18th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

Broadcast Relay Services.

In general, every step taken which may help to encourage interest in broadcasting and increase the facilities for listening to programmes, should be supported; but it is always wise to consider any innovation in a critical spirit—however promising it may appear at first sight—and see whether it is really in the public interest.

Broadcasting has, during the past year or two, provided the idea of establishing central relay services, the object of which is, first, to receive the broadcast transmissions on a powerful receiver and then to distribute the received signals over wires to individual homes. Those who subscribe to the service can then receive good-quality reproduction without owning an independent receiver. Naturally, no system of this kind could be established without first obtaining a special licence from the Postmaster-General, since the Post Office enjoys a monopoly in communication. The Post Office has, it would appear, given permission fairly freely for these broadcast exchanges to be set up by private individuals in different parts of the country, and subscribers, in turn, pay to the licensee a rental for the hire of apparatus and the lines connecting their homes with the central receiving station.

The effect of the establishment of these exchanges is likely to be far-reaching, and we are inclined to doubt whether the action of the Postmaster-General in sanctioning them is really in the best interests of the public, and whether it is not really a somewhat ill-considered action. To have broadcasting fed into your home so that you have no choice of programme, but only listen to that station which is being supplied from the central receiver, is to restrict, to a very marked degree, the service which broadcasting, under normal conditions of reception, can provide to the listener. It is hardly to be expected that those who subscribe to the one programme reception scheme will also trouble to own a broadcast receiver, so that the manufacturer suffers in loss of sales, and so also does the listener, whose service falls very short of that which he would enjoy if he owned a receiver and paid the ordinary annual licence of the Post Office.

Unless the charge made by the Post Office for a licence to run these exchanges is equivalent to what would have been obtained if the individual subscribers had each paid their 10s. annual licence fees, then the B.B.C. is being deprived of a portion of the revenue to which they would normally be entitled, and, of course, indirectly, the public is the poorer because the expenditure on programmes must, consequently, be curtailed. Nor have we, so far, seen any statement made which gives us any assurance that the sum received by the Post Office for these licences is actually shared by the B.B.C. It may, perhaps, be regarded as a separate item of Post Office revenue, to which the Postmaster-General considers the B.B.C. has no claim. It would be interesting to know the views of the B.B.C.

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A NEW DETECTOR VALVE.
BROADCAST BREVITIES.
LABORATORY TESTS ON APPARATUS.
LETTERS TO THE EDITOR.
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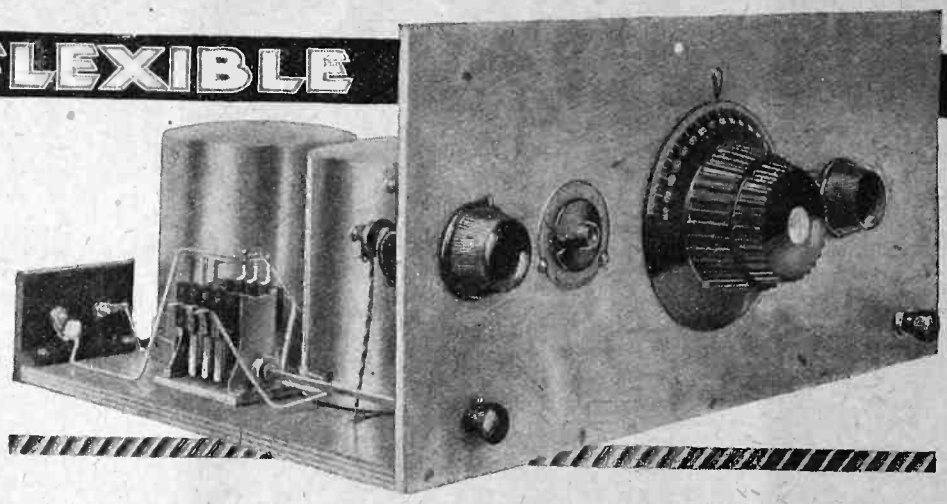
The FLEXIBLE TWO



An Inexpensive Detector-L.F. Set with Modified Band-pass Tuning.

By H. F. SMITH.

SPECIFICATION.

Regenerative grid detector and a single transformer-coupled L.F. stage.

Double-circuit filter tuning with single-knob control. Variable inter-circuit coupling by means of a small tapped inductance coil.

Tuning coils in individual screening boxes.

Reaction controlled by differential condenser, and applied to the filter coupling coil.

Reception of medium and long broadcast wavebands, with switch change-over.

IT has hitherto been necessary to preface the description of a regenerative detector-L.F. set which includes a two-circuit tuner by the statement that it will inevitably be somewhat difficult to operate, due to its four mutually dependent controls—reaction, aerial tuning, secondary tuning, and inter-circuit coupling. But since it has been proved that single-knob tuning of several cascade circuits is thoroughly practicable, this objection no longer applies, as operating difficulties tend to disappear when the two component circuits of the tuner can be adjusted as one unit.

As to whether double-circuit tuning itself is worth while must now surely be beyond doubt or controversy. The practical advantages of the system were forcibly brought home to the writer recently when he had an opportunity of making a direct comparison between a humble detector-L.F. set—with a filter—and a commercial H.F.-detector-pentode mains-fed receiver, which is one of the best of its kind, but has single-tuned circuits. As was to be anticipated, this three-valve set proved itself to have a vastly greater range, but, as regards selectivity—in the sense in which that overworked expression is generally interpreted—the less-ambitious receiver was definitely superior. As the test was made at a few miles' distance from Brookmans Park, the undoubted sensitivity of the H.F. set was almost valueless, except on the long waveband.

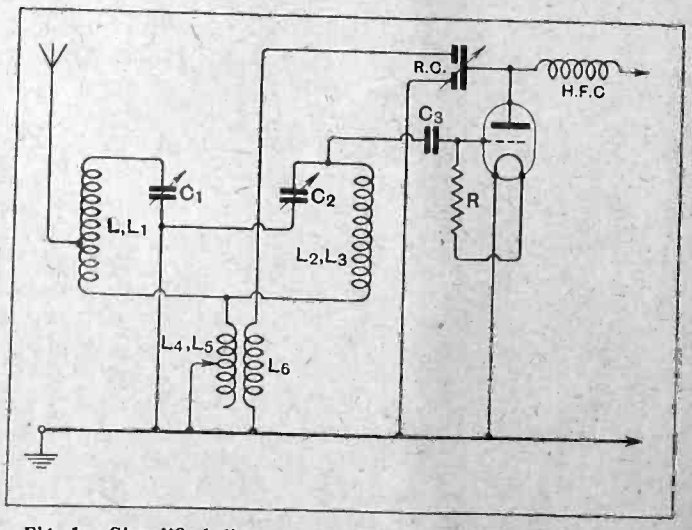


Fig. 1.—Simplified diagram of the tuning circuits and detector. References correspond with those of the complete diagram.

As the essential difference between a band-pass filter and a two-circuit aerial tuner lies only in the way that these arrangements are operated, the tuning system of the "Flexible Two" may be considered as belonging to either category or as a mixture of the two. The simplified diagram given in Fig. 1 shows that the component circuits are coupled by an inductance which is common to both; this inductance is variable, so that tuning may be broadened to any desired extent, or alternatively, selectivity may be enhanced by reducing coupling even below that value which provides maximum signal strength.

Reaction is always rather a problem when filter circuits are used, but it clearly cannot be ignored in the design of a two-valve general-purpose set without any H.F. amplification. As coupling will naturally be adjusted to the optimum value when maximum sensitivity is needed, and consequently when reaction will be applied it was judged best to feed back energy to the grid *via* the common inductance, thus ensuring that the tuning of both circuits may be affected to an equal extent.

As shown in Fig. 2, the detector and low-frequency amplifying sections of the receiver are entirely

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The Flexible Two.—conventional, and do not call for any comment. It may be pointed out that any of the more obvious modifications—power grid rectification, A.C. valves, parallel-fed coupling transformer, etc.—are quite permissible, and that the operation of the tuning system is unlikely to be affected adversely if reasonable care is taken in making any alterations that may be desirable for meeting individual requirements. The necessary coupling-reaction coil assembly may be built up in a number of ways; in this case it is wound in slots cut in a short length of 1in. Becol ribbed former, which is supported by light metal brackets below a 10-point Ferranti selector switch, through which connection may be picked up with any of the various tapping points. Dimensions and connections are shown in Fig. 3, from which it will be seen that the reaction coil L_6 is wound between L_4 and L_5, the medium- and long-wave sections of the coupling coil. L_4 comprises 20 turns of No. 28 D.S.C. wire, tapped at the 6th, 8th, 10th, 13th and 16th turns from the start. L_5, which is a continuation of this winding, has a total of 60 turns of No. 36 D.S.C. wire, tapped at the 15th, 30th and 45th turns. The reaction coil consists of 120 turns of No. 38 D.S.C., and is wound in the same direction as the other two windings; its ends are soldered to tags made by twisting short lengths of wire passed through holes drilled in one of the ribs.

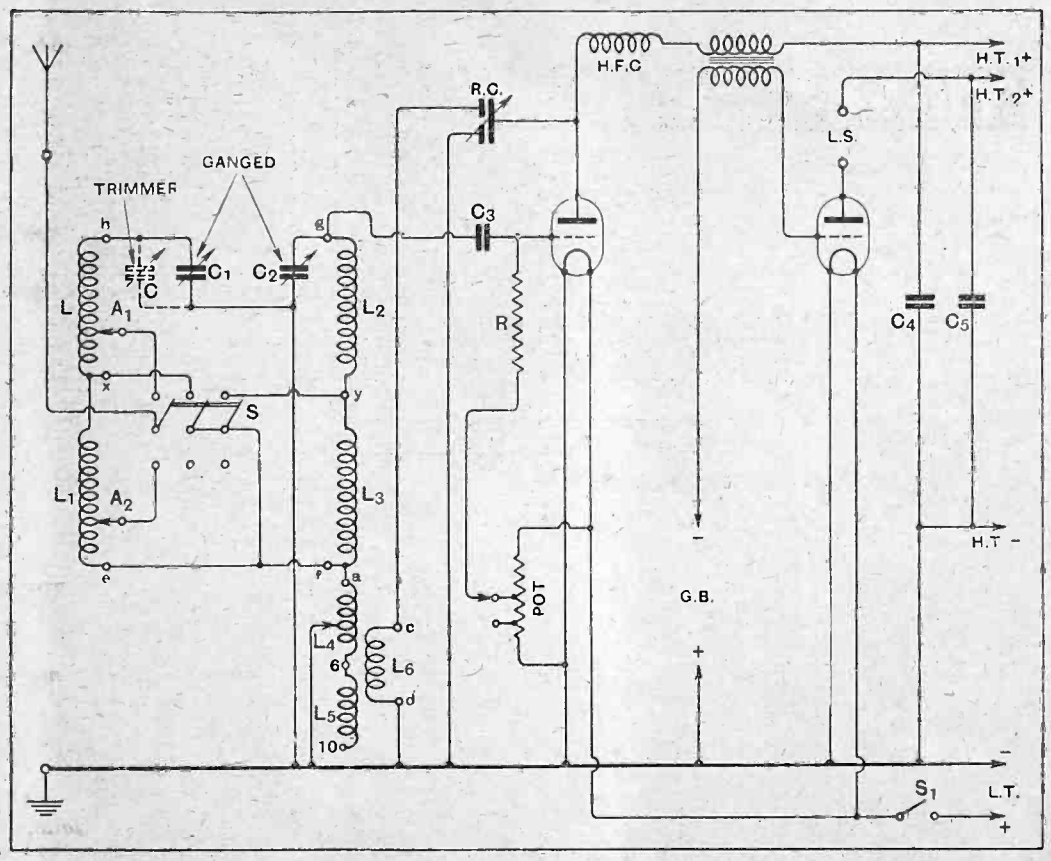

Fig. 2.—Complete circuit diagram: C, trimming condenser, 25 mmfds.; C_1, C_2, 0.00035 mfd.; C_3, 0.0003 mfd.; C_4, C_5, 2 mfds.; R.C., 0.0003 mfd.; R, 2 megohms.

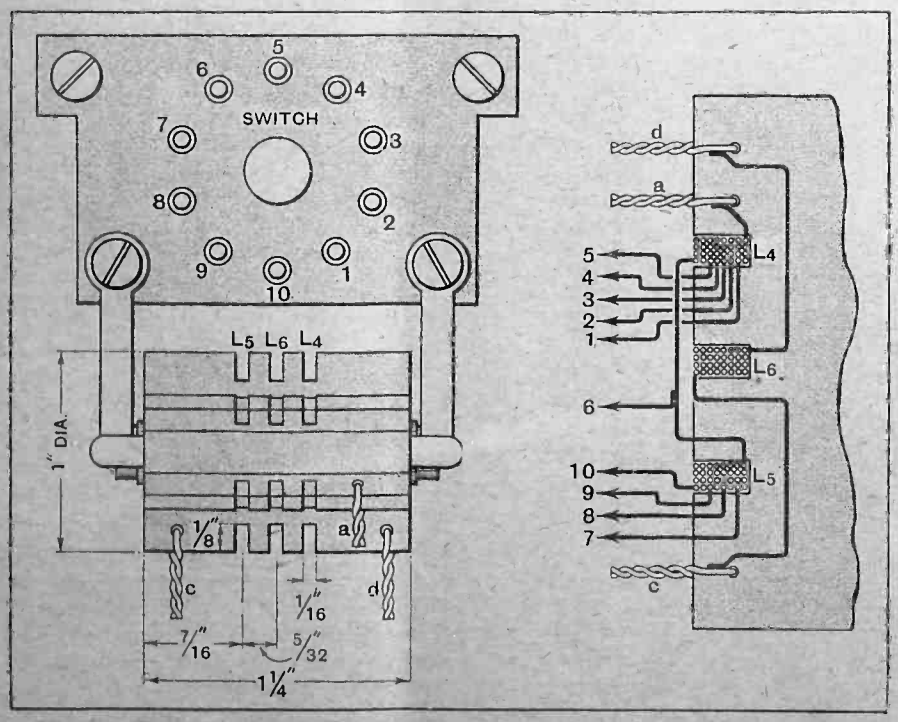

Fig. 3.—Construction and mounting of the coupling and reaction coils. The enlarged sectional diagram shows how the coils are wound; tappings are joined to similarly numbered switch studs, and terminal points bear reference lettering corresponding to the other diagrams.

Connection should be made between coil and switch before the latter is mounted on the panel, and all its back contacts (which are not shown in the diagram) must be joined together and to earth. Instead of a rotary switch it may possibly be preferred to use an arrangement of sockets, grouped in a circle on a small piece of ebonite sheet, with a wander plug for purposes of adjustment.

It will be seen from the accompanying photographs that "potted" tuning coils are used, thus ensuring that coupling may be completely under control. Ribbed ebonite formers, 3in. long and 2¼in. in overall diameter, are used in the construction of these coils, of

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LIST OF PARTS.

2 Variable condensers, logarithmic, 0.00035 mfd. (Ormond; Junior Log).
1 Friction Control dial (Ormond).
1 Dial indicator (Bulgin).
1 Flexible condenser coupler (Ormond).
1 Fixed condenser, 0.0003 mfd. (Telsen).
2 Condensers, 2 mfds. (Dubilier).
1 Trimming condenser, 0.000025 mfd. (J.B.; Midget).
1 Differential reaction condenser, 0.0003 mfd. (J.B.).
1 L.F. transformer (Ferranti A.F.4).
1 H.F. choke (Telsen).
2 Valve holders (Telsen).
1 Grid leak, 2 megohms (Ediswan).
1 Grid leak holder (Bulgin; porcelain).
1 Grid potentiometer (Lewcos).
1 Switch, single-pole, 10-way (Ferranti).
1 Switch, single-pole, on-off (Lotus).
1 Switch, 3-pole, change-over (Magnum).
2 Coil screens (B. & J.).
2 Coil formers, ribbed, 3-in. long, 2¼ in. dia. (Becol).
1 Length choke former, 1-in. dia. (Becol; Type 7A).
4 Terminals, Aerial, Earth, L.S.+, L.S. − (Burton).
2 Terminal mounts (Junit).
1 Grid bias battery, 15 volts (Pertrix).
2 Wander plugs (Lisenin).
Wire, screws, sheet aluminium, plywood, etc.

Approximate Cost, £5 : 10 : 0.

In the "List of Parts" included in the descriptions of THE WIRELESS WORLD receivers are detailed the components actually used by the designer, and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

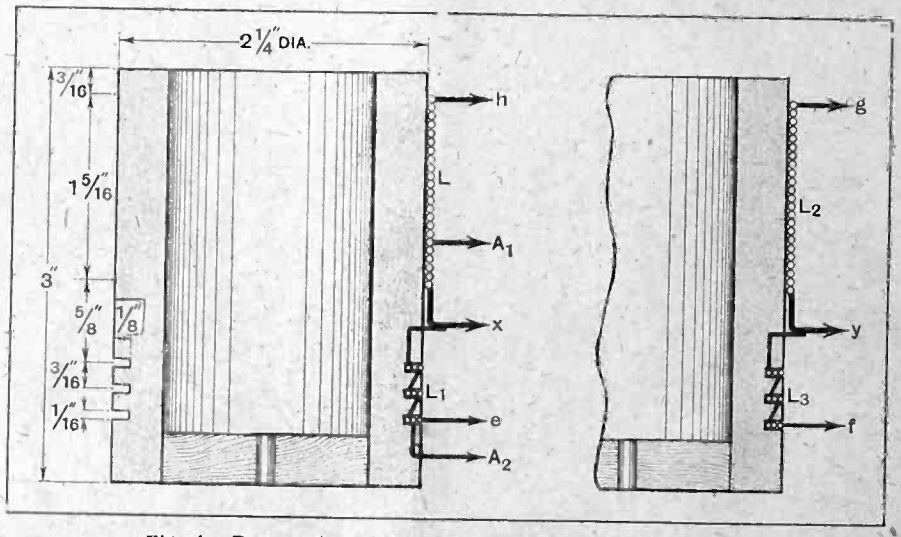

Fig. 4.—Preparation of the coil formers and disposition and connections of the windings

which the dimensions are given in Fig. 4. The separate assemblies, L, L_1 and L_2, L_3 are identical, except that the first-mentioned is tapped for connection of the aerial.

The medium-wave windings, L and L_2, consist of 78 closely wound turns of No. 28 D.S.C. wire; L is tapped at the 18th turn from the end marked *x*. The long-wave coils L_1 and L_3, each comprise three sections of 65 turns of No. 36 D.S.C.; L_1 is tapped at the 45th turn, counting from its low-potential end, for the aerial connection. Plugs of wood are inserted in the formers to act as mountings, and leads from the high-potential ends (marked *h* and *g*) and from the interconnections (*x* and *y*) are brought down inside the tubes and passed out through holes to soldering tags mounted on the lower ends of the ribs in convenient positions for external connections (see practical wiring plan, Fig. 5).

As these connections will be in close proximity to the metal bases of the screening boxes, it is as well to prevent the possibility of accidental short-circuits by interposing a thin disc of insulating material, such as paxolin, between the coils and the trays.

One is reluctant to suggest a complication that will generally be of no great value, but it should be pointed out that double-wound aerial input coils, with separate primary windings, confer certain advantages from the point of view of selectivity. Simple tapped coils, as described, are quite adequate for average receiving conditions, but when used in the immediate vicinity of a transmitting station may be responsible for a certain amount of preventable interference, particularly at the lower end of

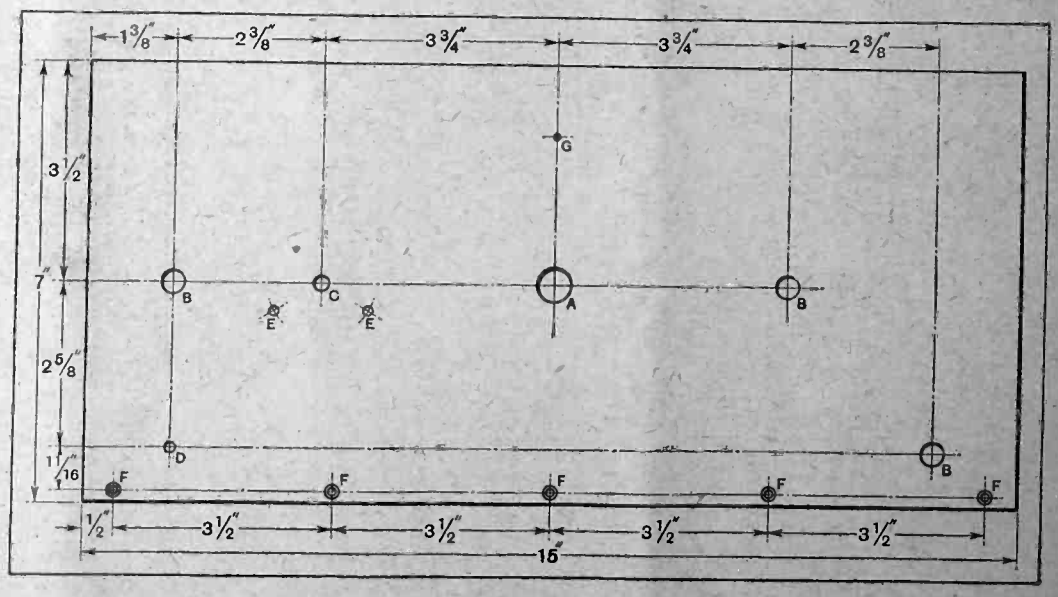

Fig. 5.—Drilling details of the front panel, which is of plywood, 1/4in. thick. A, 9/16in. dia. B, 3/8in. dia.: C, 1/4in. dia.; D, 3/16in. dia.; E, 5/32in. dia.: F, 1/8in. dia., countersunk; G, 3/32in. dia.

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The Flexible Two.—

the long-wave tuning scale. This is due to the fact that the filter coupling coil, which is common to both circuits, is also in series with aerial and earth.

Condenser Screen and Mounting Bracket.

By providing separate medium- and long-wave aerial coils, with about 18 and 30 turns, connected in series and with a short-circuiting switch across the long-wave section, this source of trouble is effectively overcome. The alternative plan of earthing the low-potential ends of the tuning coils and inserting the coupling coil between the variable condensers and earth is not satisfactory, as it does not make for stable operation when reaction is used.

A simple vertical screen of heavy-gauge aluminium sheet is placed between the variable condensers to act as an electrostatic shield; it also serves as a support for C_2. There is no need to insulate the fixing bush of this condenser; indeed, in this case it is convenient to pick up connection with the frame and moving vanes through the screen.

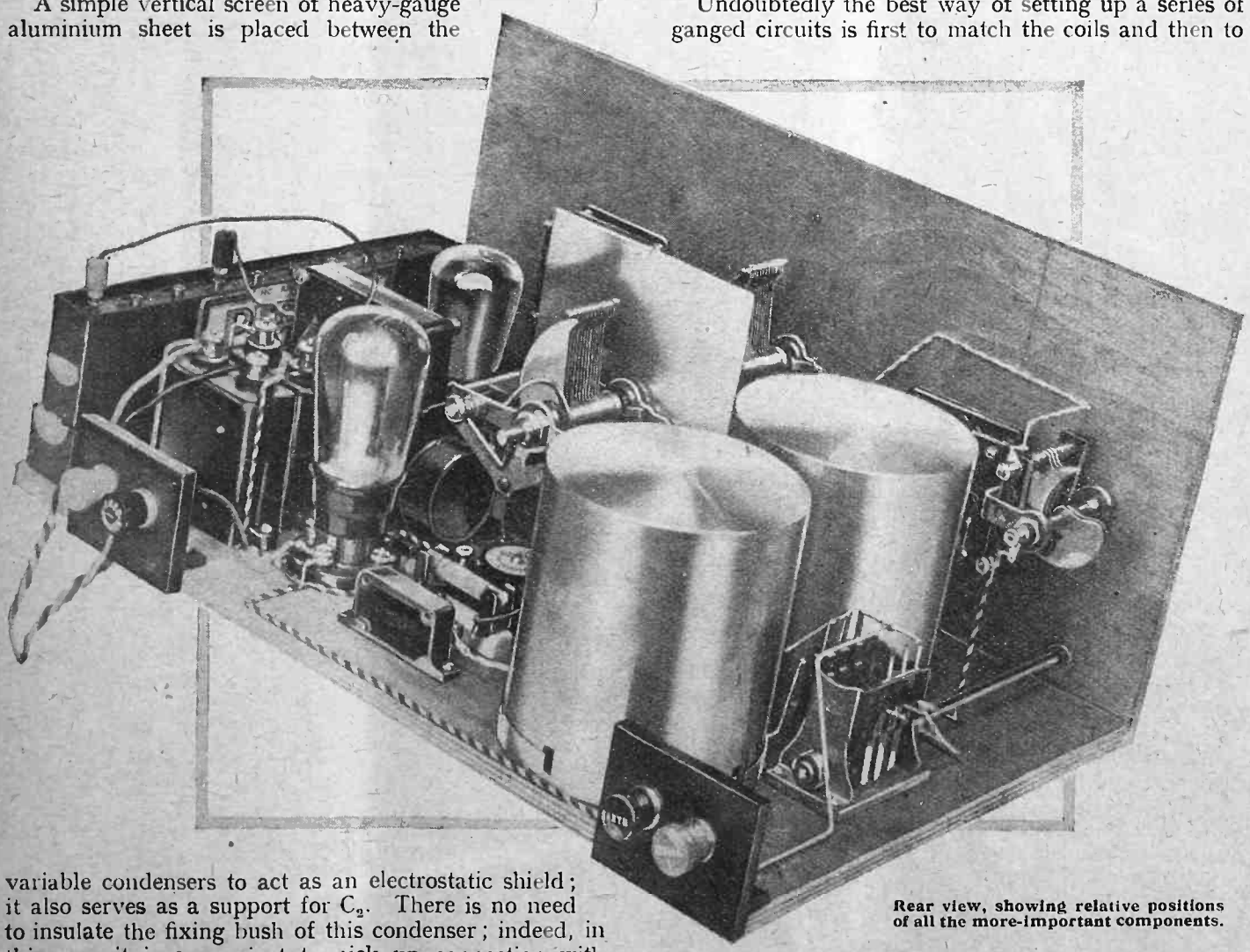
It will be observed that a tapped potentiometer is fitted so that the operating potential of the detector may be adjusted to that value found to give the best compromise between good detection and smoothest reaction control. This fitting must be regarded as a refinement when two-volt valves are used, but, with higher filament voltages, it may be included with advantage.

Before attempting to set up the filter circuits, the constructor would be well advised to assure himself that the detector and L.F. amplifier are working properly. To make this test, the aerial may be joined, through a very small condenser, to the junction between L_2 and C_3. Under these conditions, signals should be receivable, and reaction should work fairly well, provided that a sufficient number of turns are included in the coupling coil.

If everything is found to be in order thus far the aerial connection should be restored to its terminal, and the operation of balancing the circuits may be undertaken. It is assumed that the coils will have been carefully and evenly wound, with an identical number of turns; this is important, as close matching of inductance is desirable.

Undoubtedly the best way of setting up a series of ganged circuits is first to match the coils and then to equalise the stray capacities across each circuit; if the variable condensers are right it is then certain that correct tuning will be maintained when individual rotors are in line. A good deal of information on this subject has recently been published in *The Wireless World*.

In the case of the present receiver matters are so arranged that, with an average aerial, the incidental capacities in the primary and secondary circuits are practically identical, so it is probable that at least



Rear view, showing relative positions of all the more-important components.

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The Flexible Two.—

something will be heard without the need for making individual adjustments to the rotors, and with the trimming condenser set at zero. Coupling becomes tighter as the number of turns in the common inductance is increased, and it is best to start with the selector switch at about the fourth stud; having obtained some sort of signal (preferably at about the middle of the medium frequency band), coupling should be loosened by rotating the switch knob in an anti-clockwise direction.

Unless the special precautions already mentioned are observed, the normal procedure is to loosen one of the nipping screws securing the condenser coupler, and, with the trimming condenser set at the lowest possible value giving a margin of control, to adjust the rotors independently until maximum signal strength is obtained. If tuning is then found to be imperfect at either end of the scale, an adjustment of the trimmer must be made, but one's aim should be to arrange matters so that this control need not be used to any great extent. These adjustments should always be made with the loosest possible inter-circuit coupling, and preferably without reaction.

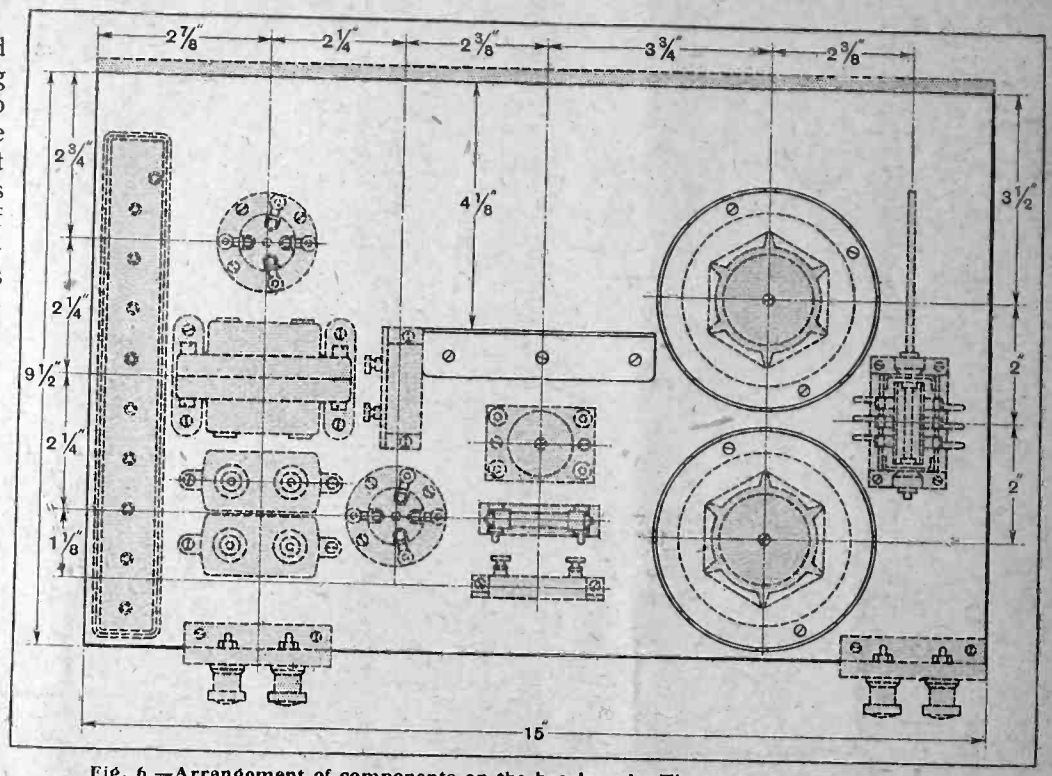
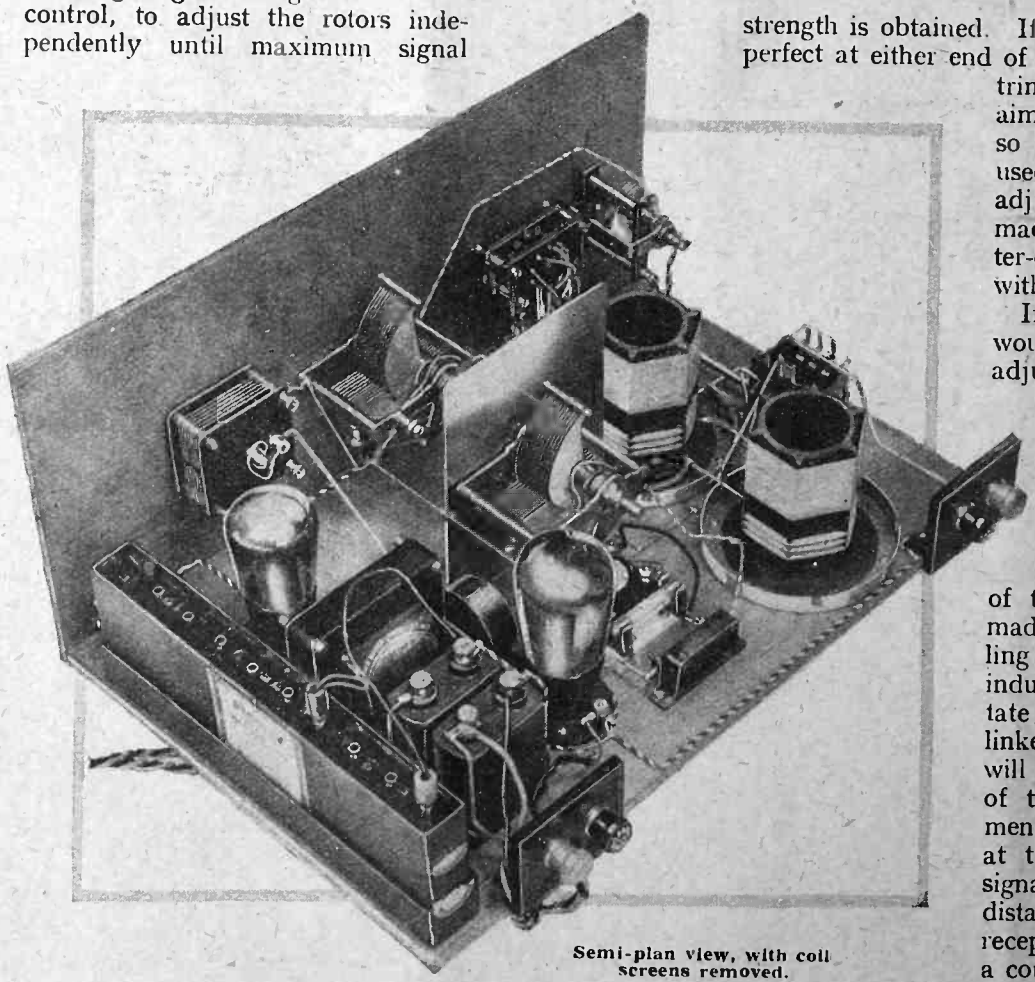


Fig. 6.—Arrangement of components on the baseboard. The vertical screen is 5½in. high and 4in. wide.

If the coils have been carefully wound it is likely that the condenser adjustment will hold when passing over to the long waveband; if it does not, a suitable number of turns should be removed from the coil found to have the highest inductance.

When initial adjustments of the tuning system have been made, the effect of varying coupling may be tried. Any change in inductance of the coil will necessitate a slight readjustment of the linked variable condensers, but will not disturb the relative tuning of the two circuits. As already mentioned, this control will be set at the position giving maximum signal strength when searching for distant stations, but for "quality" reception of near-by transmissions, a coupling should be chosen which



Semi-plan view, with coil screens removed.

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The Flexible Two.

provides either broad tuning or actually a double "hump," with maxima about two degrees apart on the condenser scale. The switch indicator dial should be positioned so that it shows clearly when the rotating brush is making proper contact with a single stud; short-circuits between adjacent studs will give rise to misleading results.

Reaction and coupling controls are, as usual, to some extent interdependent, but fortunately there is a compensating effect; the tendency towards self-oscillation becomes greater as the number of coupling turns are increased, but this is partially offset by the fact that, when the adjustment is made, a greater proportion of the aerial load is thrown on the secondary circuit. Reaction may fail when coupling is inordinately loose.

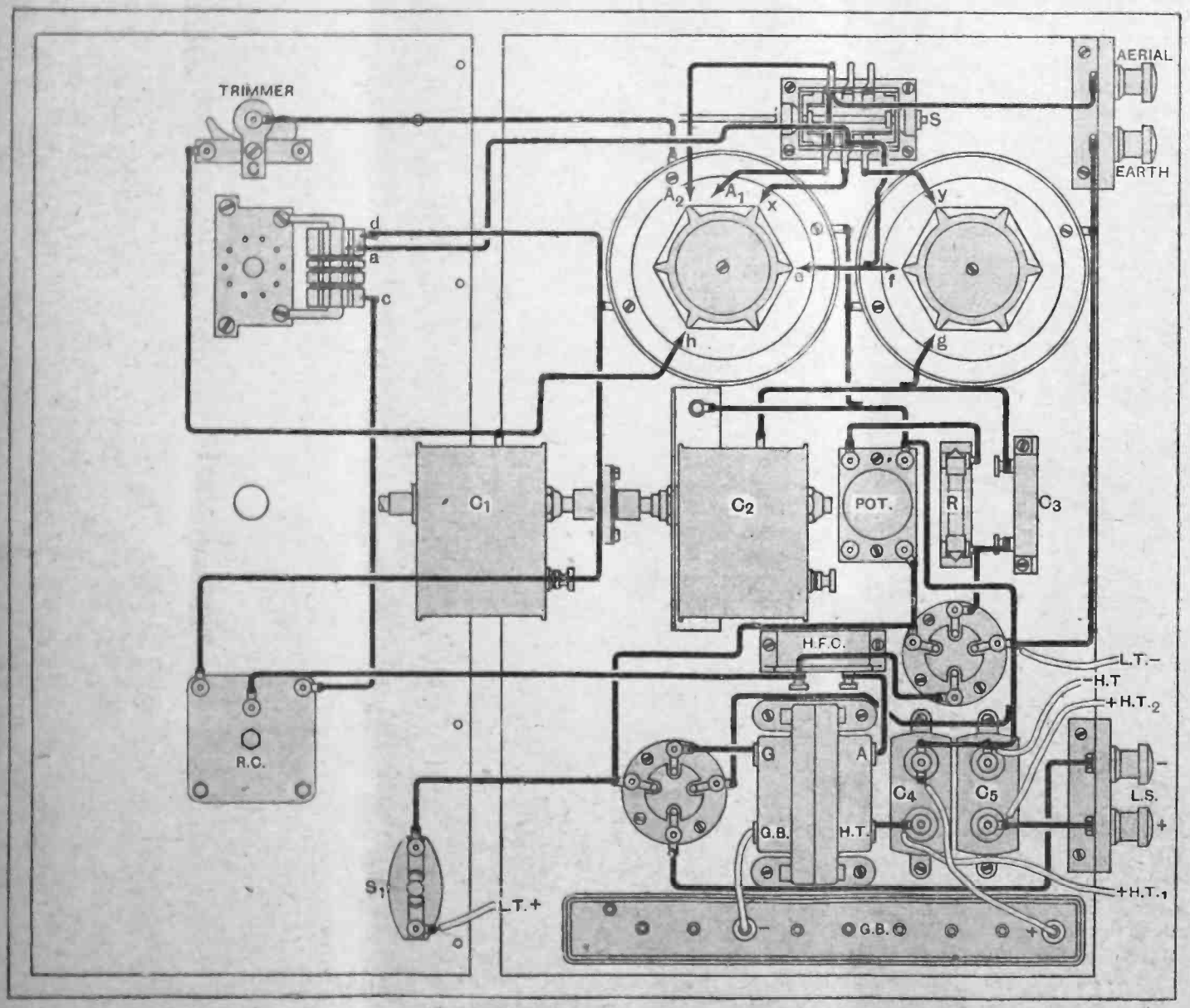

Fig. 7.—Practical wiring plan. Connection is made between the coupling control switch spindle and the point marked *d*. Note that the coil screen bases and the condenser shield are earthed.

To suggest that an input volume control may be a desirable addition will possibly seem like an implied overestimate of the capabilities of a simple detector-L.F. set. But when a really large input is received from the local station, detector overloading will be produced unless some means of reducing signal voltage is provided; the usual expedient of detuning is not permissible, as by doing so the advantages of a filter are partially lost. If a pre-detection control is fitted it should preferably be of the type that does not greatly affect tuning.

A final word regarding the wave-changing switch. As it is undesirable that long connecting leads should be used in the oscillatory circuits, this component is mounted close to the coil screens, and is operated through a length of square-section steel rod (supplied by the makers). The end of this rod is fitted with a small knob.

This receiver is available for inspection at the offices of "The Wireless World," 116, Fleet Street, London, E.C.4.

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Unbiased

—"FREE GRID"—

Gramoscope or Cinegram?

Truly we live in a remarkable age, in which men of science are constantly demonstrating astounding wonders to us, and yet I doubt whether we ever receive greater shocks than on the memorable occasion over three centuries ago when—as certain American history books tell us—Dr. William Gilbert first demonstrated the potentialities of electricity by rubbing his fountain pen on Queen Elizabeth's silk stockings. All the same, I received quite a shock the other day when I was invited by a scientific friend whose name is well known at the Patent Office to a private demonstration of an apparatus which he described by the none-too-euphonious but highly descriptive name of "Radiogramoscope," although, at my suggestion, he is considering the alternative name of "Radiocinegram."

Dr. William Gilbert's experiment:

In appearance the machine resembled a modern radio-gramophone, although its fore and aft dimensions seemed rather greater than usual. On opening the lid I was surprised to find that the usual turntable and gramophone pick-up were replaced by two electrically driven cinematograph reels and a photo-electric cell; I at once accused my friend of plagiarising an ultra-modern type of gramophone of which a brief description has already been given in this journal, and which, in my opinion, will eventually oust the ordinary type of gramophone, whatever "discophiles" may say to the contrary. My friend, however, advised me not to make a fool of myself by jumping to conclusions, and bade me be seated in front of the instrument. I did so, and immediately noted that the usual loud speaker front of silk and fretwork had been replaced by some white fabric.

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"Coming Shortly."

My friend adjusted a record consisting of a large reel of cinematograph film, and to my astonishment there burst forth simultaneously from the loud speaker the familiar strains of "We Sail the Ocean Blue" and the opening scene of *H.M.S. Pinafore*. I sat enthralled for a few moments as the familiar sight and sound of Gilbert and Sullivan's opera reached me, but I soon jumped up to unearth the secrets of this remarkable version of "home talkies." It was, of course, nothing more nor less than an all-mains radio receiver, combined with a sound-on-film talkie apparatus, with the exception that instead of the picture being projected across the room on to a screen it was actually thrown on to the front of the instrument by a machine somewhat resembling certain sub-standard cinema projectors which are upon the market; the whole apparatus was, therefore, extremely compact. This fact, of course, accounted for the somewhat large fore and aft dimensions of the instrument which I have already mentioned.

My friend informed me that he had at first encountered a very great difficulty owing to the fact that the loud speaker obviously could not be placed immediately behind the screen as it would then block the projection of the picture. He eventually overcame the trouble in an ingenious manner by using an exponential horn. The projector is mounted on the top of the final straight portion of this horn, and the "eye" of the redressing mirror associated with it protrudes slightly through the back of the horn. This does not in any way upset the quality since, of course, no escape of air takes place, and a small correction is made to counteract the effect of this slight protrusion through the back of the horn.

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Fooling the Public.

I have been studying some of the advertisements in foreign radio journals recently, and I must say that reading the tall stories told in many of them gives one the impression that the people in the country concerned must be very simple-minded folk indeed. In the early days of radio in this country we were not entirely free from this sort of thing, and I dare say that many readers will remember a certain instrument, which, according to its makers, had "a soothing effect on the ether waves," and others will probably remember an H.F. valve which was guaranteed not to burn out even if 20,000 volts were applied to its filament pins; the reason being, of course, that it had no filament, its internals consisting merely of a small by-pass condenser between the grid and plate connections. It thus acted merely as a passenger, and I must confess that in this respect it was no more worthy of condemnation than certain valves which did have normal electrodes. Needless to say, these articles did not manage to trickle in

"One leg was longer than the other."

to the advertisement pages of this journal. Even in these enlightened days certain people interested in radio take advantage of the technical ignorance of the average man in the street, and I well remember noticing this year at Olympia that as people left a certain stand they were walking with a decided limp due, I presume, to the fact that one leg was longer than the other.

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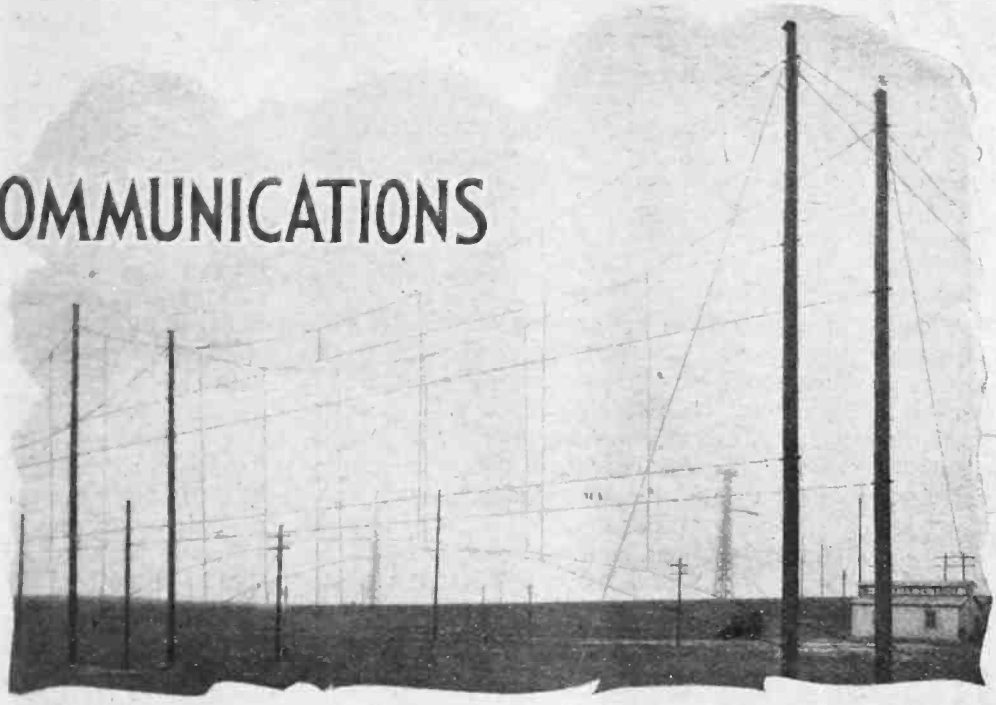
WIRELESS COMMUNICATIONS

A Record of the Year's Progress

By Lt.-Col. CHETWODE CRAWLEY, M.I.E.E.



Aerial arrays at the Baldock Station.

THE most notable advances of the year in wireless communication must be placed to the credit of wireless telephony.

At the beginning of 1930 there was much discussion both in Parliament and in the Press as to whether the Government should develop wireless telephone services with the Empire through its own stations or through the beam wireless telegraph stations of the Imperial and International Communications Company. Under the previous Government the Imperial telegraph services had been leased to the Company, but the question of how the Government would develop the telephone services had been left open.

In the summer of last year the Company had invited the Government to work the telephone services through the Company's beam stations, and a Cabinet Committee was appointed to advise on the matter. The question at issue was whether these Imperial telephone services should be worked through the beam telegraph stations of the Company or through the Government's transmitting station at Rugby, with its complementary receiving station at Baldock. Questions of a highly technical nature arose, and the Government decided to consult two independent experts of acknowledged repute, Dr. F. E. Smith and Professor G. W. O. Howe. As a result, the Government felt justified in concluding that, without disparaging the possibilities of the Marconi system, at least as efficient services could be provided from Rugby, with certain economic advantages in prospect, and on the 26th of February the Postmaster General announced in the House of Commons that the Government had decided to develop these telephone services from the Rugby-Baldock stations.

Point-to-point Telephony.

The transatlantic wireless telephone service worked from the Rugby station has been in operation since January, 1927, on a wave of 5,000 metres, and an additional channel was opened in June, 1928, using short waves. Later, two more short-wave channels were put into operation, and at the present time arrangements are being made for a second long-wave channel. The receiving apparatus for the original long-wave channel is at Cupar in Scotland, and that for the new one will be there also. This combination of long- and short-wave services has ensured a good commercial transatlantic service throughout the twenty-four hours, and has linked up practically the whole of Europe with the United States, Canada, Mexico, and Cuba.

The charges for this transatlantic service were reduced in July last, and now vary from £2 a minute (minimum of three minutes) between this country and the first U.S.A. and Canadian zones, to £3 between this country and Mexico and parts of Cuba.

On the 30th of April a commercial telephone service was opened on short waves with Australia from the Rugby-Baldock stations, at the same minimum charge of £6 for three minutes' conversation. This service is available for nine hours daily. A direct service with the Argentine has just been opened, and it is expected that direct services with Canada and South Africa will be opened shortly, as well as a service with New Zealand, *via* Australia.

A number of other commercial wireless telephone services have come into operation during the year, all on short waves, which are, of course, much more economical than long waves for working over great distances. The reason why long-wave channels are, however, being retained for the transatlantic service, in addition to short-wave channels, is that they are more reliable, and the additional expense is justified, though it certainly would not be justified for less fully loaded services over greater distances.

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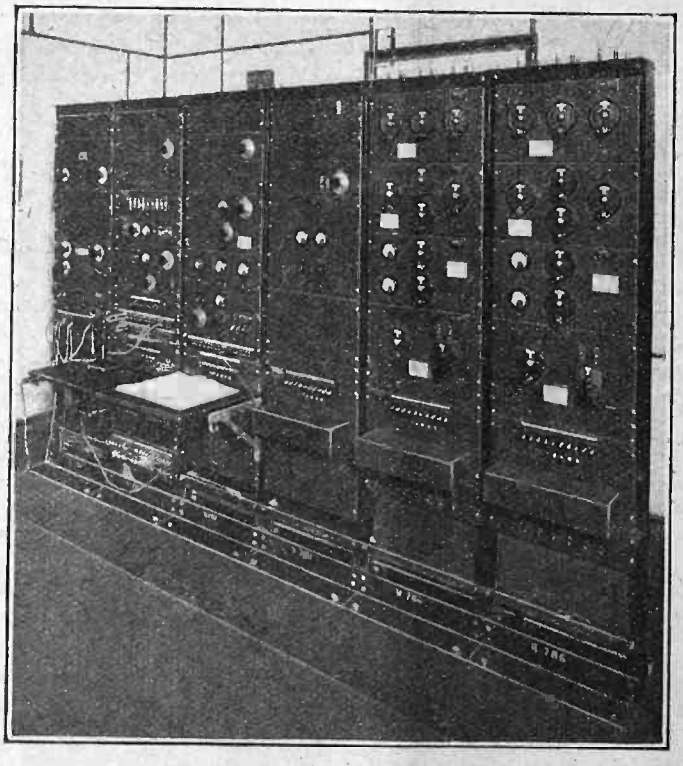
Wireless Communications.

Notable amongst other services which have come into operation this year are the services between New York and Buenos Aires, which connect up subscribers in North and Central America with subscribers in the Argentine, Uruguay and Chile, the services between Germany and Spain on the one hand, and Brazil, etc., on the other, and the service between Australia and New Zealand.

Ships' Telephony.

Great strides, too, have been made during the year in developing wireless telephone services with ships. Up to the beginning of the year no ships, with the exception of a few whalers and other fishing craft, made any use of telephony for commercial communication. This was because marine wireless telegraphy had reached a high state of development, whereas wireless telephony, the only other competitor outside visual range, was far less efficient, and more expensive. As soon, however, as short-wave working became a possibility for ships it was obvious that telephony would struggle up to its own, in spite of the inherent technical advantages of telegraphy. It has still a long, and apparently expensive, journey to travel, but early this



A Post Office telephone receiver at the Baldock Station.

year it made a definite start; indeed, it really got off the mark on the 8th of December last year, when a commercial service was opened between New York and the *Leviathan* on her way to Southampton, communication being maintained up to a distance of 2,600 miles. The next step was taken on this side, when the Post Office opened a service with the *Majestic* on her voyage to New York on the 14th of February, and announced that it was ready to extend similar facilities to any other ships on the North Atlantic routes. Several transatlantic liners are now fitted, and passengers in them can converse comfortably with telephone subscribers on either side of the Atlantic. The shore end here is worked by the Post Office from the Rugby-Baldock stations. The charge made is £4 10s. for the first three minutes' conversation, and £1 10s. for each additional minute.

These telephone services with ships present many difficult technical problems, due to two hard facts; first, the space in ships is strictly limited, and, secondly, the ranges over which communication is required are constantly altering. The first fact means that the ship's telegraph and telephone apparatus must always be comparatively close together, which leads to interference difficulties, and, also, that, through lack of space, apparatus must be very compact. The second fact means that the eternal wavelength troubles, due to congestion in the ether, are accentuated. At present, five short wavelengths are being used on this very limited transatlantic service, and it is obvious that one cannot go on at that rate for very long. At the moment, however, the number of passengers who wish to converse (at the price) is small, which is as fortunate technically as it is unfortunate financially. But all these troubles are only growing pains, and what has been done in this first year of commercial services clearly shows that telephony with ships at sea will come into its own much sooner than could have been reasonably expected a few years ago.

A rotating beacon station showing the revolving loop aerial.

During the year, wireless telephony in general has been kept well in the public eye, not only by the world-wide broadcasts of speeches by eminent persons, but also by many interesting demonstrations, such as offices and even aircraft in South America communicating with ships near England, railway magnates in London talking to railway magnates in trains in Canada, aircraft over Los Angeles conversing with business men in Berlin, doctors in Madrid diagnosing heart troubles in Buenos Aires, banquets all over the world listening to the same speeches, and even ships in the Mediterranean switching on lights in Australia.

All such experiments, useful and interesting as they are, can hardly be included, however, in a short résumé of commercial progress, though, indeed, one

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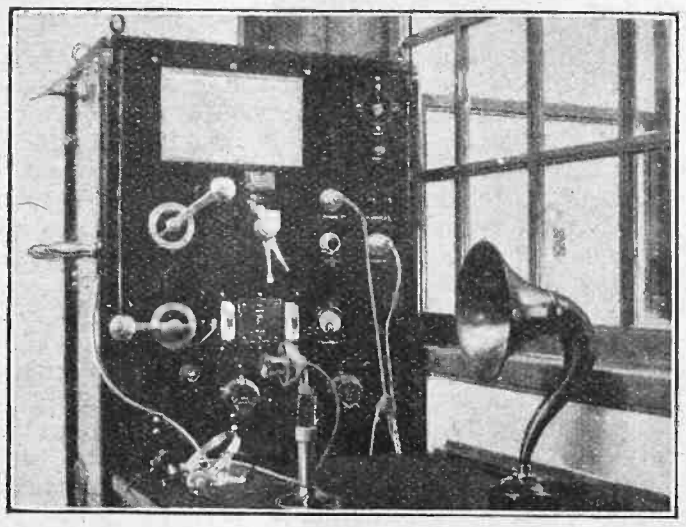
Wireless Communications.—
of the most interesting, which took place last month, may be fitly added to the list, as it really was a commercial communication, viz., a subscriber in Melbourne speaking to a subscriber in Los Angeles. The route, the longest over which commercial telephone communication has been effected, was from Melbourne to Sydney by land line, Sydney to England, and England to the U.S.A. by wireless, and New York to Los Angeles by land line.

Point-to-point Telegraphy.

So much for telephony in 1930. We must now turn our attention to telegraphy, and here we find that progress, though sure, has been less spectacular, and even disappointing from the commercial point of view. The disappointment is not due to any slackening in technical achievement, but to that "world depression" with which we are all so painfully familiar, as well as to those magnetic storms of which the chairman of the Wireless Section of the Institution of Electrical Engineers has recently told us. It appears that these storms were peculiarly severe in 1930, and account for a falling off in the number of hours of recordability on short-wave circuits. But the main trouble with commercial wireless telegraphy during the last year has undoubtedly arisen from the "world depression," which showed up less in telephony, apart from the transatlantic circuit, as there were no comparative results for previous years.

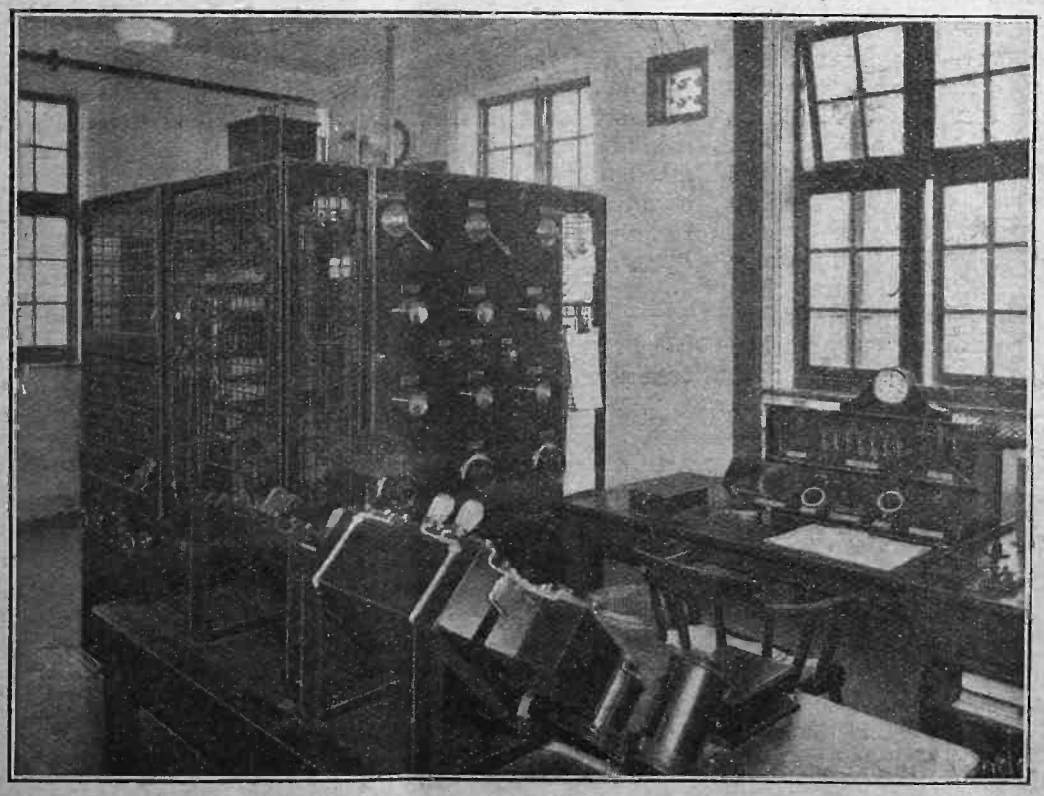
The number of long-wave telegraph circuits showed little, if any, increase during the year, but it is understood that the Imperial and International Communications Company contemplates having an additional long-wave circuit for its transatlantic telegraph service. Some new medium-wave circuits were opened, but the real increase was in short-wave circuits, many of which came into operation all over the world.



A wireless telephone set at the Post Office station at the Humber, used for communicating with fishing craft, etc.

The practical experience gained with these short-wave commercial services during the last few years gave many data which have formed the basis of experimental investigation during the year, and fading, the great bugbear of short-wave working, naturally came in for the lion's share. At the receiving end use has been made of separate or spaced aerials, and modulation of the transmitter's output has been proved effective in certain cases, while many varieties of beam aerials have been used with success. Short-wave working is still largely in the experimental stage, but meanwhile it has been plugging away satisfactorily for commercial communication ever since the Marconi Company successfully staked its reputation on the erection of our Imperial beam telegraph stations.

For several years now it has been the practice to concentrate transmitters at one place, receivers at another place, and operation at the central offices in a city, but during this last year there has been a tendency to erect transmitters and receivers on the same



The transmitting instruments, the main receiver and the directional receiver at the new Post Office coast station at North Foreland.

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Wireless Communications.—

site wherever possible. This has not, of course, become general practice, but it is a notable move towards economy in running costs, the most expensive item in wireless communication.

Picture-Telegraphy.

Facsimile transmission has made great strides experimentally during the year, though it has hardly made a start yet from the commercial point of view.

The Marconi Company has indeed worked a commercial transatlantic service on long waves for some years, and pictures have been sent on short waves experimentally over its beam telegraph circuits. Many experiments too, have been carried out with ships, and it is hoped that before long it will be found possible to start commercial services. The fact is that for long and medium waves the technical difficulties are not great, but for short waves these difficulties have proved serious, and the year has slipped by without the hoped-for opening of commercial services. Next year the story may be different.

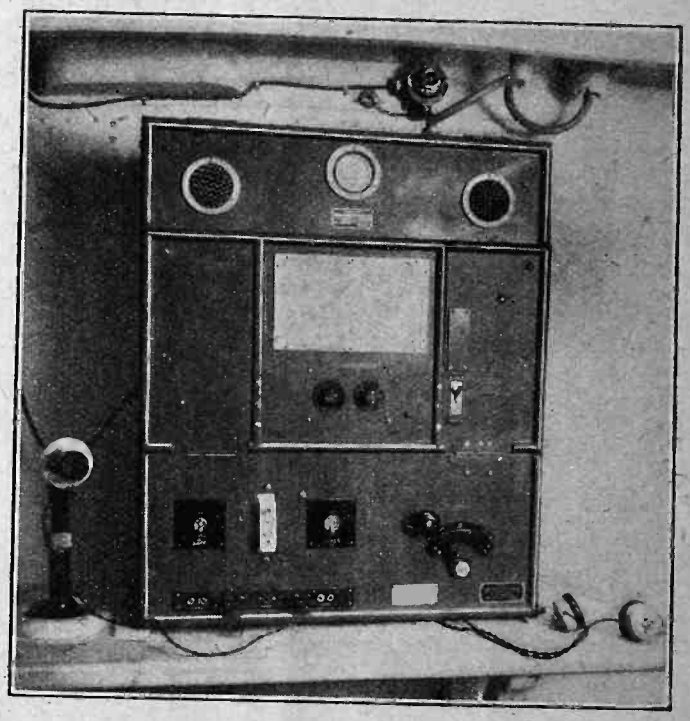
There can be no doubt that there is a great commercial future for this form of wireless communication, and its rather tardy début has been disappointing to many who recognise the possibilities.

Ships' Services.

As regards ships' communications, apart from telephony, the most important advances have been made in short-wave services. Some three hundred ships are now fitted with short-wave installations, as compared with half that number a year ago, and the commercial traffic on short waves is increasing steadily, though this increase is, to some extent, at the expense of the long-wave traffic. Still, much of it is new traffic, and this will increase rapidly when short-wave working becomes more stabilised, and has reached the stage where world-wide communication with ships can be considered as normal practice.

Directional apparatus for navigational purposes has also been improved during the year, and will come into even more general use when the Safety of Life at Sea Convention is brought into force internationally next summer. Already more than one-fifth of the total number of ships fitted with wireless have directional apparatus installed, a very marked advance on the meagre number of a few years ago.

Many wireless beacon stations have been erected throughout the world during the year. A few of these are of the revolving pattern, from which ships can obtain bearings on an ordinary non-directional receiver, and it is in this class of beacons especially that, with the aid of such devices as the Adcock aerial, great technical advances are confidently expected.



The Marconi Company's telephone transmitter in the new Dover lifeboat.

A good deal of work has been done in wireless telephone communication with trains, especially on the Continent and in Canada, and commercial services are available on certain long-distance trains, but most train installations, like those of the L.N.E.R., just inaugurated, have been fitted in connection with the reception of broadcast programmes, which is a matter outside the scope of this article. So, too, are the advances made in television, which will one day advance to the entertainment stage, from which it will be warmly welcomed, to the more prosaic stage of commercial communication.

TRANSMITTERS' NOTES.

R.S.G.B. Tests and Competitions.

The December issue of the "T. and R. Bulletin," which is well known as the Official Journal of the Incorporated Radio Society of Great Britain and the British Empire Radio Union, gives particulars of several tests and competitions planned for the early part of 1931.

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28-megacycle Tests.

On January 4th, 11th, 18th, and 25th the annual tests on the 10-metre waveband will be open to all members of the R.S.G.B. in the British Islands. Space does not permit of full particulars being given in these columns, but these may be obtained from Mr. R. W. Leader (G5VL), Porth, St. Columb Minor, Cornwall, who is organising these tests, and to whom reports should be sent. Competitors are asked specially to concentrate upon reflector systems, whether designed for directional work or not, and to compare the results with those obtained previously without the use of any reflecting system. Only stations distant more than 100 miles should be included in reports.

G5VL asks those who write to him on the subject of these tests to enclose a stamped and addressed envelope.

The 5-metre Waveband.

The four Sundays in February are set aside for the annual tests on 56 megacycles, which it is hoped will produce interesting results.

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Interference on the 7 mC. Band.

Amateurs working on the 7 mC. waveband are experiencing some trouble from commercial stations encroaching on this strictly preserved territory. One correspondent writes that he has heard RPK (Moscow) on 7,190 kC. with an I.C.W. note that is audible on either side of his frequency, and has also heard EAK on about 7,130 kC.

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CURRENT TOPICS

Events of the Week in Brief Review.

1931.

The Wireless World takes the opportunity on the last day of 1930 to wish readers in all parts of the world a Happy and Prosperous New Year.

L. OF N. AND SHORT WAVES.

"Day," "night," and "twilight" wavelengths are to be used by the short-wave station to be built for the League of Nations by the Société Française Radio-électrique. During daylight the wavelength will be 15 metres, at night 35 metres, and at dusk periods 18 metres.

FRENCH BROADCASTING CHAOS.

The story of the French barber who displayed the sign: "To-morrow I will shave gratuitously" is recalled by the present situation in French broadcasting, writes our Paris correspondent. The late Postmaster-General, M. Mallarmé, seemed on the point of securing legislation to control broadcasting when the Cabinet collapsed. The new party in power is not likely to pursue the same policy, so broadcasting remains in as chaotic condition as ever!

RADIO AND BACCHUS.

The sobering influence exerted by broadcast receivers in public houses was referred to at a recent meeting of the Leeds Watch Committee. "The Chief Constable informs us," said Alderman N. G. Morrison (chairman), "that where such installations exist the conduct of the patrons has been good, and this he attributes to these installations, which appear to induce quietude."

400 KW. FROM PITTSBURGH?

Transmissions on a power of 400 kilowatts will shortly be carried out by W8XAR, auxiliary of KDKA, Pittsburgh, if the Federal Radio Commission grants the necessary permit. It is intended at first only to transmit on high power between the hours of 6 and 11 a.m. (G.M.T.) on a wavelength of 306 metres. If facilities are granted, W8XAR will be the highest-powered broadcasting station in the world.

IRELAND'S HIGH-POWER STATION.

We understand that the Irish Free State Government has finally decided to erect the new high-power broadcasting station at Athlone, and that it is hoped to have the station working before the end of 1931. Athlone possesses a good trunk telephone connection with Dublin, where the studios will be situated. The actual site of the station has not yet been divulged, but it is believed that Government land in the neighbourhood of the town will be selected. The apparatus will be constructed at the Chelmsford works of the Marconi Company.

Listeners in Britain whose sets are unselective will be interested to know that the transmitter, although rated at 60 kilowatts, will contain provision for an increase of power to 120 kilowatts! The wavelength will be 413 metres.

A RADIO RELIC.

A lonely hut marring the landscape near Babylon, Long Island, New York, has just been identified as the first commercial wireless station built by Marconi in the United States. According to the best information, says "The R.C.A. News," Marconi erected the station in the late autumn of 1900, or the early winter of 1901. This was before he amazed the world by flashing the letter "S" across the Atlantic. The shed, which resembles a large dog-kennel, might be mistaken for a tool-house or chicken coop. Its existence was accidentally discovered by Captain H. J. Round, who, while on a recent visit to Major E. H. Armstrong at Bayport, Long Island, expressed curiosity as to what had happened to the original station at Babylon, at which he had been third assistant technical officer. The two engineers motored to the site, and Captain Round immediately recognised the shed, on which were a number of old insulators.

This interesting relic has been handed over to the Radio Corporation of America for preservation.

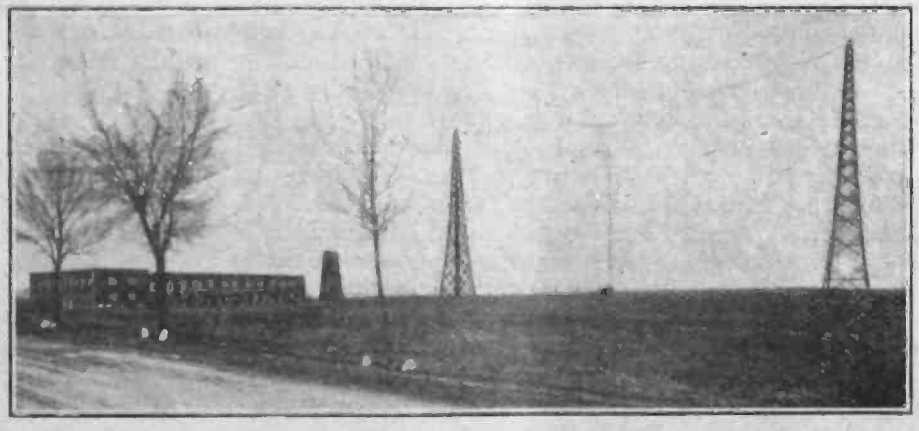
RECORD AIRWAY WIRELESS CHAIN.

The most comprehensive airway wireless system ever evolved will, it is stated, be in operation with the opening by Imperial Airways during 1931 of the 8,000 miles' air line between England and South Africa.

During the whole of the eleven days spent on the journey between London and Cape Town passengers will be in wireless touch with ground stations. Long- and short-wave communication will be employed, and messages will be both by telegraph and telephone. Wireless bearings will be available to pilots throughout the flight over seas, rivers, forests and jungles.

It is expected that a transmission range of 300 miles will be attained. During flight power will be derived from a dynamo driven by a small air-screw.

Though the bulk of the wireless work will be conducted on the normal 900-metre wavelength, some interesting test transmissions will be carried out on 30-40 metres.



HEILSBERG. A comprehensive view of a typical German high-power station, of which there will be nine in the proposed new broadcasting scheme. The long, low transmitter house resembles the station building at Brookmans Park. The water-cooling tower and low-voltage feeder wires can be clearly seen.

NEW YEAR GREETINGS BY RADIO.

The Postmaster-General announces that facilities are available for the transmission of New Year greetings through Rugby Radio, Portishead Radio, and other Post Office wireless stations to ships at sea. Messages can be sent *via* Rugby Radio (charge 1s. 6d. a word) to ships on all seas, or *via* Portishead Radio or other stations (charge 11d. a word) to ships up to five days' voyage from ports in the British Isles.

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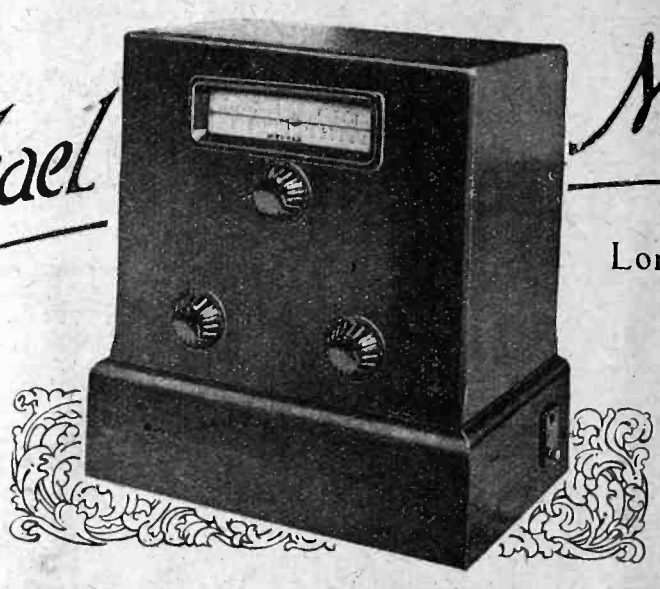
The McMichael Mains Three



Long-range Receiver with One Dial Control.

THAT the possession of a reputation for excellence carries with it special cares and responsibilities none will admit more readily than the successful wireless manufacturer. To retain public confidence he must steer a middle course between dangerous conservatism and risky experiment. Such a course has been steadily pursued by the firm of McMichael, who, in producing the "Mains Three" receiver, have once again proved their ability to hold and augment a reputation established many years ago. Designed with the simplest possible controls, the set is bound to appeal to the general listening public. The single tuning dial, which moves a pointer across an illuminated scale calibrated in wavelengths is fascinating to handle and is likely to set a new fashion. In the case of, say, twelve of the most powerful European stations, together with those in this country, it is only necessary to move the pointer to the desired wavelength, when, on depressing the mains switch, the selected transmission will be heard. By judicious use of reaction (the right-hand control seen in the title illustration) and the selectivity-cum-volume control (on the left) many more stations can be logged.

The set which is housed in a well-finished walnut cabinet is built as a chassis, and can be easily withdrawn. From the illustration on the opposite page the ingenious drive mechanism for the horizontal tuning scale is seen. The centre knob on the front of the cabinet controls the twin-gang condensers by a reduction gear, and on the rear end of the rotor spindle is a large pulley controlling a cord with pointer attached. Small jockey pulleys act as guides and maintain the right tension. Screening has been carried out with the greatest care—there being separate and total enclosure of both tuning condensers and inductances. The aerial and tuned anode coils, wound on 1½in. formers, are contained in a copper box below the variable condensers, and the single screen-grid valve is surrounded by a removable aluminium hutch. The eliminator is built as a separate metal-shielded unit in the base of the chassis and feeds the valves through five connectors neatly grouped together on small polished ebonite terminal strips. Servicing has been simplified by arranging that the wiring of the receiver and mains unit is readily accessible.

Probably one of the most ingenious pre-H.F. volume controls yet devised is included in the aerial circuit. The left-hand dial on the front of the cabinet actuates the wave band and pick-up switches (arranged below the H.F. and detector valve holders) by means of a long spindle. This terminates in a crank attached to a connecting rod and piston clearly visible in the illustration. The piston and cylinder into which it works form two elements of the volume control condenser. Extreme rotation clockwise gives the maximum transference of aerial energy (and hence greatest volume) on the medium wave-band, whilst rotation in the other direction gives increasing volume on the long waves. A position mid-way between the two puts the pick-up in circuit. The many functions of this dial are clearly marked, and its handling becomes a matter of simplicity in a very short time.

Interesting Volume Control.

Inside the cylinder containing the large piston connected to the aerial is a second and smaller piston which forms the third electrode of the differential condenser which is earthed (see circuit diagram). The relative dimensions and movements of the component parts of this assembly are such that control of volume, and, incidentally, selectivity, is not accompanied by any appreciable change in the aerial capacity thrown on to the first tuned circuit, with the result that ganging is not upset; furthermore, the special construction makes a very low minimum capacity possible. In this way the volume of the local station may be reduced practically to zero. In some receivers with a conventional series aerial condenser as a volume control adequate reduction of signal strength is impossible.

On the main terminal panel which is still exposed when the back of the cabinet is screwed home, there are sockets for loud speaker and pick-up jacks and nickelled terminals for aerial and earth wires; also, there is provision for the use of the electric lighting or power mains as an aerial for local-station reception. To prevent shock due to accidental contact with live terminals, it is arranged that the removal of the back of the cabinet breaks the main circuit.

In general, the circuit is orthodox, but there are a number of small refinements which merit description. Tuned anode coupling between the screen-grid valve and the leaky-grid detector is employed, but as it is necessary to maintain the common rotor spindle of the ganged condensers C_1, C_2 at earth potential, the anode

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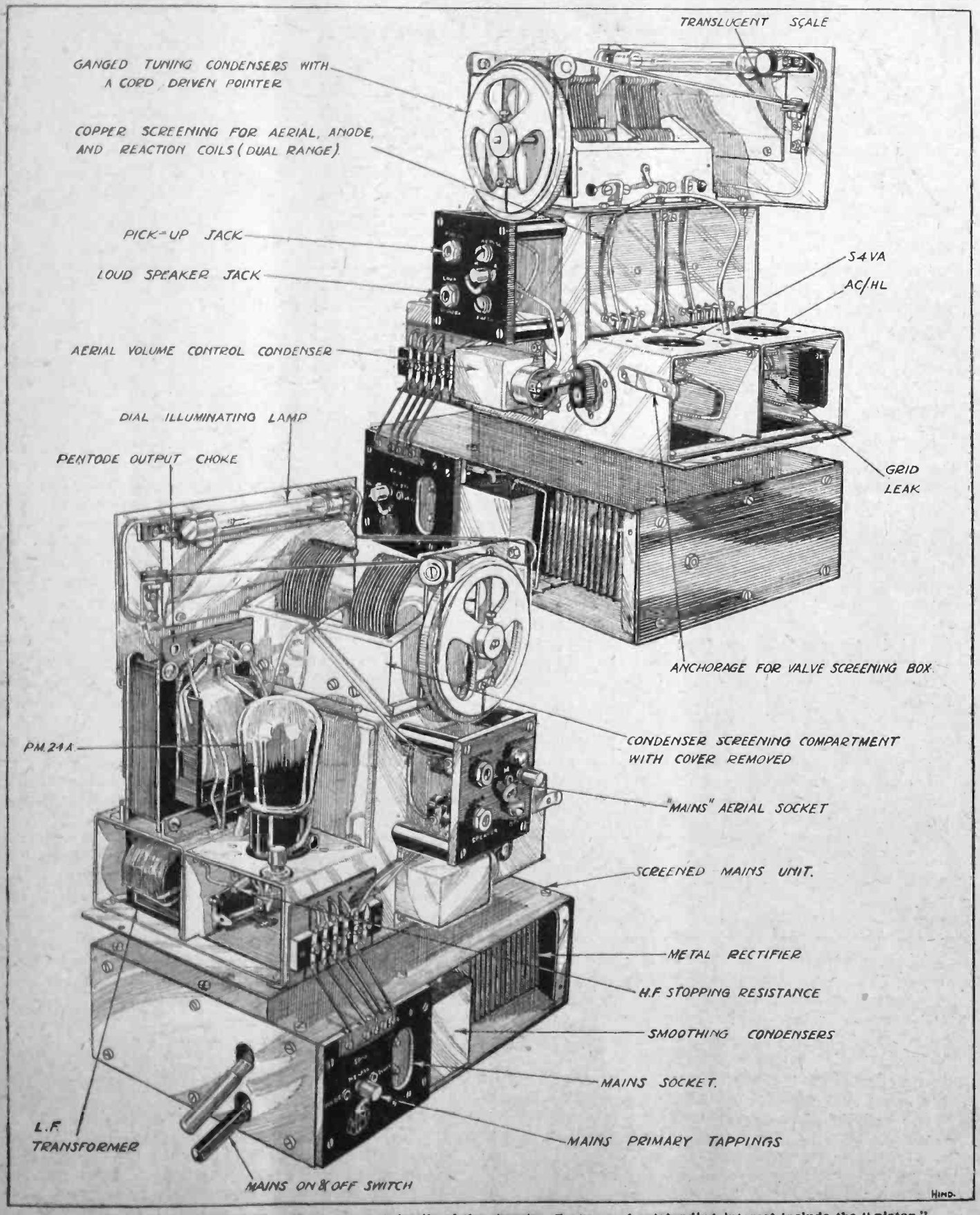

McMICHAEL MAINS THREE.—Constructional details of the chassis. Features of outstanding interest include the "piston" type volume control and the cord-driven pointer tuning device.

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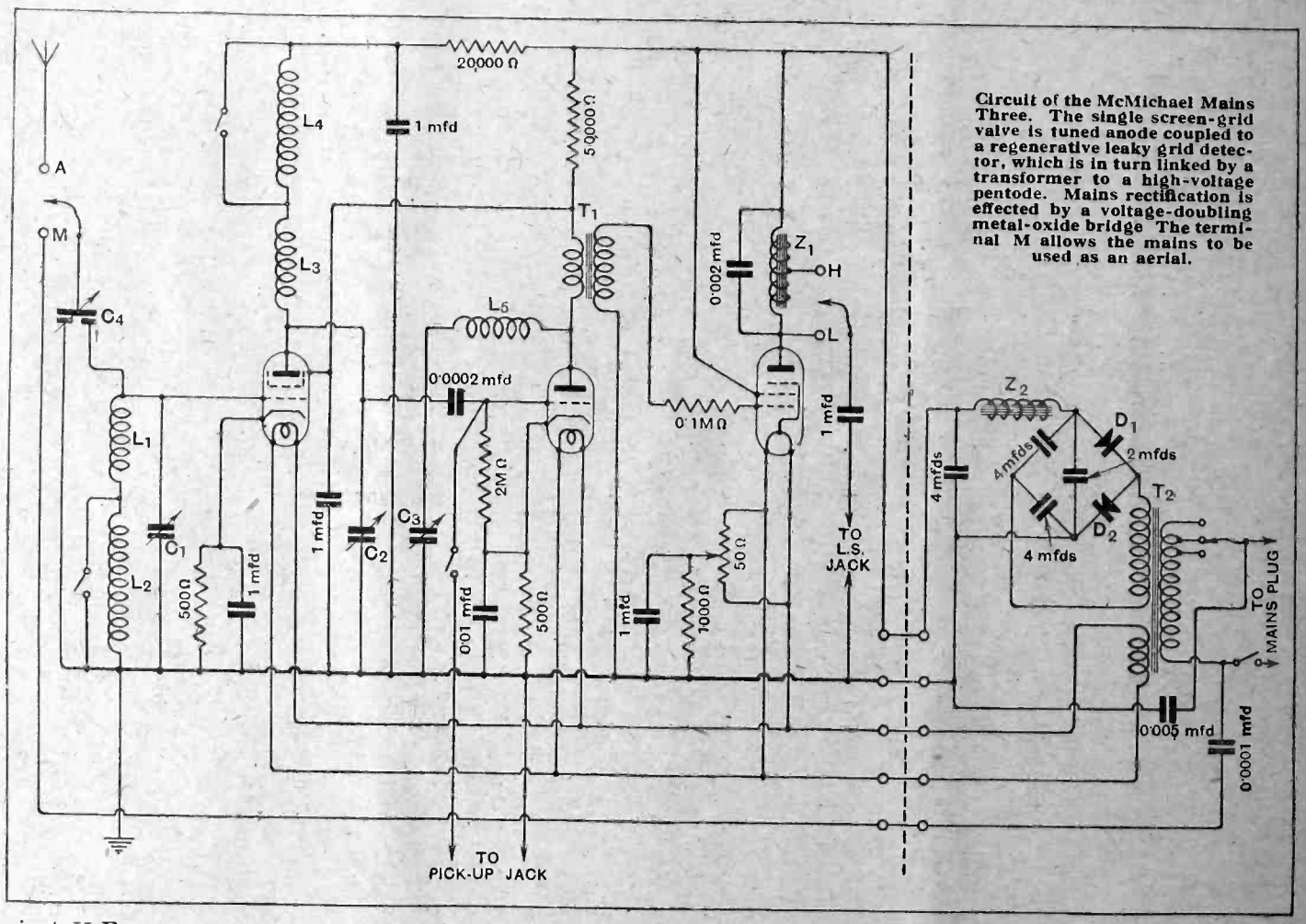
The McMichael Mains Three.—

condenser is connected as shown in the diagram and not directly across the coil. The three valves used are the Mullard S4VA (screen-grid), the Mazda AC/HL (detector), and the PM24A high-voltage pentode; their anode circuits are well decoupled, and the screening-grid of the H.F. valve, which at first sight appears to be fed through a 50,000 ohm series resistance, really derives its current from a potential divider—one arm of which is the detector valve. No H.F. choke is to be found in the plate circuit of the detector; presumably the primary of the intervalve transformer deflects sufficient H.F. energy, as the behaviour of the reaction condenser C_3 is perfectly satisfactory. An H.F. stopper of 100,000 ohms is included in the pentode control grid circuit, and the anode circuit of this valve contains a centre-tapped choke and impedance-limiting device or compensator which prevents the accentuation of high notes when certain types of moving-iron speaker are used. One side of the mains is connected to earth through a 0.005 mfd. condenser, thus minimising 50 cycles modulation by shunting away local H.F. energy.

When tested about seventeen miles south of London after dark, the set gave a very good account of itself, no fewer than fourteen stations on the medium band being received at good loud-speaker strength without interference. On the long waves, Hilversum, Kalundborg, Warsaw, Eiffel Tower, Daventry, Königswusterhausen, Radio Paris, Lahti and Huizen were received satisfactorily, with the exception of Königswusterhausen, where there was slight interference from Daventry. Moscow could be heard with reaction pressed to the limit. The minimum local station spread was about 40 kc. at 356 metres.

An undistorted A.C. output of a little over one watt, which is more than sufficient for domestic needs, is available from the output stage. The quality of reproduction is excellent, and fully vindicates the claim so often made in this journal that the high-voltage pentode when compensated can give an account of itself that is not excelled by any triode. There is a very slight residual hum, but this is not heard during a programme. The ganging holds well over both the wave bands, and is not affected by the volume or reaction controls. Great care has been taken by the makers to match the coils and condensers together with stray capacities before assembling the set, and trimmers have not been found necessary. The wavelength calibration was never more than 2 metres out on the medium band. At twenty guineas the "Mains Three" is very good value for money. The makers' address is: L. McMichael, Ltd., Hastings House, Norfolk Street, Strand, London, W.C.



Circuit of the McMichael Mains Three. The single screen-grid valve is tuned anode coupled to a regenerative leaky grid detector, which is in turn linked by a transformer to a high-voltage pentode. Mains rectification is effected by a voltage-doubling metal-oxide bridge The terminal M allows the mains to be used as an aerial.

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A NEW DETECTOR VALVE

The Marconi and Osram H2 Valve Tested.

THE valve which is the subject of the present review is known as the H2, and is intended as a high-magnification amplifier, or as a detector valve, and is especially suitable, owing to its comparatively low consumption in the anode and filament circuits, for sets in which dry batteries are used as the source of supply.

The rated characteristics of the valve are as follows:

Filament voltage ..	2.0 volts.
Filament current ..	0.10 ampere.
Anode voltage (max.)	150 volts.
*Amplification factor ..	35
*A.C. resistance	35,000 ohms.
*Mutual conductance or slope..	1.0 milliamp. per volt.

*At anode volts 100, grid volts 0.

On checking the mutual conductance of the valve tested, taking the same standard conditions as were used in the official test, it was found that the valve had an even higher slope than claimed by the makers; the figure found was 1.14 mA/volt. The possession of so high a slope as this entitles the valve to rank as one of the most efficient two-volt valves available.

A full set of grid-volts/anode-current curves are shown in Fig. 1, together with a grid-current curve for $E_a = 80$. It will be noted that grid-current starts at $E_g = +0.15$ volt, so that it is necessary to supply a small negative grid-bias when the valve is used as amplifier. The steepness of the grid-current curve suggests that the H2 will make an unusually sensitive and distortionless grid rectifier; for this purpose it is suggested that the anode voltage be as high as convenient, and that a grid leak of about 2 megohms be used in conjunction with a grid condenser of the order of 0.0001 mfd.

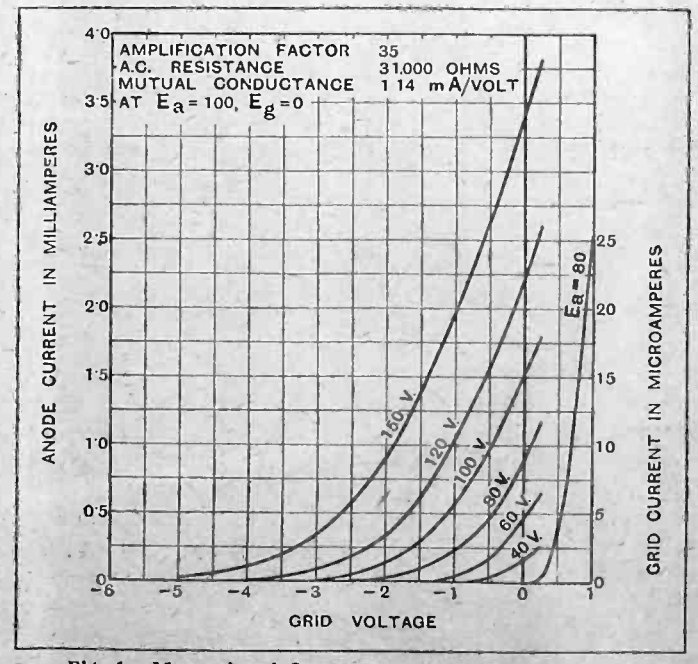

Fig. 1.—Marconi and Osram H2 valve. Grid volts/anode current curves and grid volts/grid current curve.

Owing to its comparatively low A.C. resistance, the valve will provide good amplification with but small loss of high notes when used with a resistance in its plate circuit. Either as grid detector or as first L.F. amplifier, a resistance of 150,000 ohms is suggested as suitable coupling to the next valve, though as an anode-bend rectifier a higher resistance would increase the sensitivity.

Fig. 2 gives a set of anode-volts/anode-current curves, from which the behaviour of the valve as an amplifier can be determined in detail. Each curve refers to a different value of negative grid-bias, as the figure shows. From these curves it is possible to read off the A.C. resistance of the valve, as expressed by the slope of the curve, for any conditions of working; in addition, by drawing in certain other lines that cut through the curves, the anode current drawn by the valve with any desired value of resistance in its plate circuit can be found.

In the figure a series of lines are drawn across the curves; all these lines are parallel, and all represent an anode resistance of 150,000 ohms, external to the valve. That this is so can be seen from the fact that the line passing through 1 milliamp. on the anode-current scale also passes through 150 volts on the voltage scale, and by recalling that 150 volts are needed to drive a current of 1 milliamp. through 150,000 ohms. Lines representing an anode resistance of

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A New Detector Valve.—

200,000 ohms, in the same way, would all be parallel to a line joining 200 volts to 1 milliamp.

If the battery voltage is 150, for example, and the anode resistance 150,000 ohms, the anode-current taken by the valve at any selected grid-bias is given by the point at which the line AB cuts the appropriate curve. With one volt grid-bias, the current taken by the H2 would thus be 0.4 milliamp., rising to 0.56 milliamp. with zero grid-bias. The same points also give the D.C. voltage assumed by the anode of the valve itself; it is 90 volts or 66 volts for the two cases named. The points where the curves cut the other lines shown give corresponding information for other battery voltages, using the same value of anode resistance.

The utility of these curves is not by any means exhausted when these data as to static working conditions have been found. Suppose the valve is working at the point O; that is to say, the battery voltage is 150, the grid-bias 1 volt, and the anode resistance is 150,000 ohms. If a signal be applied to the grid, the momentary grid-voltage will be swung up and down about the fixed point O; if the peak value of the signal voltage is exactly one volt, the voltage on the grid will swing between the points P and Q. Inspection of these points shows that the voltage at the anode of the valve will swing in sympathy between the values 66 and 112 volts; a total swing of 46 volts, making a peak voltage of 23 volts (on either side of the steady value of 90 volts). The amplification provided by the valve, which gives out 23 volts of signals for every one volt applied to its grid, will thus be twenty-three times. Further, since the distance OQ is more than nine-elevenths of the distance OP, the distortion introduced by the valve in handling a signal of this magnitude will be less than 5 per cent. (the generally accepted limit), so that the H2 may safely be used at the operating voltages named to feed any output valve that does not require a grid-bias greater than 23 volts with an anode voltage of 150.

When used as a detector, the H2 will naturally not be capable of providing so large an output of signals before overloading begins, for the valve then has to deal with quite large high-frequency voltages to obtain even a small output of rectified signals. As a set-off against this, however, there is the fact that with the small amount of positive bias used when the valve is operating as a grid detector, the A.C. resistance is low enough to permit the use of a transformer, provided this has a primary of very high inductance, without loss of bass notes. The comparatively small current drawn by the valve will not saturate the core of an iron-cored transformer, though some of those using special alloys would have their performance seriously upset if called upon to carry 3 milliamps. through their primary.

If the valve is to be used as a detector, it will necessarily be connected in parallel with a tuned circuit. This being the case, it seemed desirable to enquire whether the base of the valve introduced appreciable high-frequency losses. On putting the matter to the test, it was found that at 250 metres the damping effect of the unlighted valve was equal to that of a non-inductive resistance of 1½ megohms.

Although a loss exists it is small and may be neglected in all but the most exacting conditions. A valve of similar type, but made (by the same makers) some two or more years ago, was found to introduce about five times the losses of the H2; we are glad to be able to make the inference that the matter of base-losses is having the makers' attention.

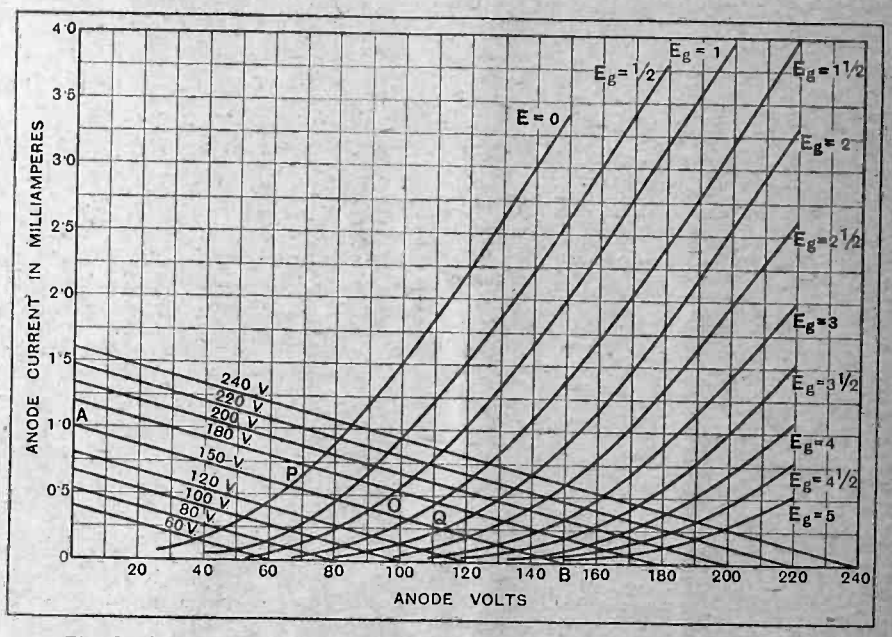

Fig. 2.—Marconi and Osram H2 valve. Anode volts/anode-current curves, with load lines for 150,000 ohms.

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PARLOPHONE SOUND-TEST RECORDS.

Two Recent Additions.

IN addition to the three original test records which were reviewed in the issue of this journal for August 21st, 1929, two new records have been recently released, the numbers being P9797 and P9798. Each of these records contains eight sine-wave constant frequencies distributed at octave intervals throughout the useful musical range as follows:—

Record No. P9797: 32, 64, 128, 256, 512, 1,024, 2,048, 4,096 cycles.

Record No. P9798: 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 cycles.

The duration of each frequency is approximately 40 seconds, and a plain groove is cut in the space between each frequency band to locate the needle point at the end of each section.

As in the case of the previous records, the recording has been carried out by the Heinrich Hertz Institute at Berlin. The price of the new records, which are obtainable only from the Parlophone Co., Ltd., 81, City Road, London, E.C.4, is 15s. each.

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Broadcast Brevities

By Our Special Correspondent.

A Broadcast Satire.

If recent broadcast plays have contained more than a touch of morbidity, the balance should be redressed on January 16th when Du Garde Peach's new play, "The Path of Glory," specially written for the microphone, will be broadcast on the National wavelength.

I hear that the play is an entertaining satire on war. In the imaginary conflict both sides are striving to lose, since it is recognised that it is the defeated nation that comes off best as regards taxation and the general aftermath of the campaign.

The play will be repeated on the Regional wavelength on January 17th.

oooo

Radio Drama on the Continent.

Radio drama in Britain absorbs a comparatively small amount of the programme time, but on the Continent it is different. The Bureau Internationale de Radiofusion has just issued some interesting figures in regard to European radio drama during the past year or two. Since February, 1930, the number of plays broadcast in the countries covered by the Union has exceeded 600; the total since March, 1929, is approximately 1,500.

oooo

A New Art.

About one-third of the number were written specially for broadcasting, and the critics declare that many of them can really be classed as examples of a new art.

Germany takes the radio play very seriously, and her output easily exceeds the modest British total of four per month.

oooo

A Tribute From Canada.

On the subject of radio drama a "bouquet" for the B.B.C. has just been received from Canada.

It comes from Mr. E. A. Weir, Director of Radio for the Canadian National Railways, who has now returned to the Dominion after a personal survey of broadcasting in Europe.

oooo

Where Britain Leads.

"It may be hard for some to conceive of New York being second to Europe in anything," writes Mr. Weir. "Nevertheless in the production of radio drama and in education broadcasting America is undoubtedly in second place.

"Production methods for radio dramas in Great Britain are definitely ahead of those in America."

oooo

Return of Mr. Vernon Bartlett.

Mr. Vernon Bartlett, who has been on a lecture-tour of America, returns to the microphone at Savoy Hill in the New Year, with a new series of "The Way of the World." The first of his reviews will be broadcast on January 8th.

oooo

Those Piano Transmissions.

It is generally conceded that the microphone has no more difficult instrument to deal with than the common or garden pianoforte. Both in wireless and in gramophone reproduction it is the piano which comes crashing in to spoil an otherwise beautiful illusion of re-creation.

oooo

A Sparring Match.

Unfortunately for Savoy Hill, however, it is demonstrated daily by the B.B.C. engineers that almost perfect reproduction of the pianoforte is not impossible. This fact at once removes any excuse for the sometimes atrocious quality of the piano transmissions during the weekly talks on music. If the piano can be conquered once it can be conquered again, but the engineers and the piano seem to be engaged on a sparring match which has lasted ever since 1922.

oooo

The Knock-out.

If the engineers appear to be winning during the early part of the evening, the piano shows its perversity later on in (strangely enough) a music talk. A few blasting blows and where are the engineers?

oooo

An Official Listener.

Where are they, indeed? Are they listening?

I addressed a few questions to a B.B.C. official. He assured me that every word and every note emanating from the transmitting aerial is listened to by a responsible official of the B.B.C. In fact, a log is kept.

A Case in Point.

I put this log to the test. On a recent Tuesday, I pointed out, my home set gave excellent reproduction of the pianoforte part in a performance of the Gershom Parkington Quintet on the National transmitter. The set was then switched off until later in the evening when Mr. Victor Hely-Hutchinson's music talk was listened to on the same wavelength. No adjustment had been made to the set, yet the pianoforte reproduction was distressing.

oooo

What the Log Revealed.

The log book was consulted and it was found that, whereas the Quintet performed that evening in No. 4 studio, the music talk was given in No. 3. Beyond this no explanation was offered for the disparity of the two transmissions, and I can only imagine (*a*) that No. 3 possesses a poor microphone or (*b*) that the room is architecturally unsuitable.

oooo

A Possibility?

It would be a happy triumph if the engineers completed their conquest of the piano by the time the B.B.C. moves into "Broadcasting House."

oooo

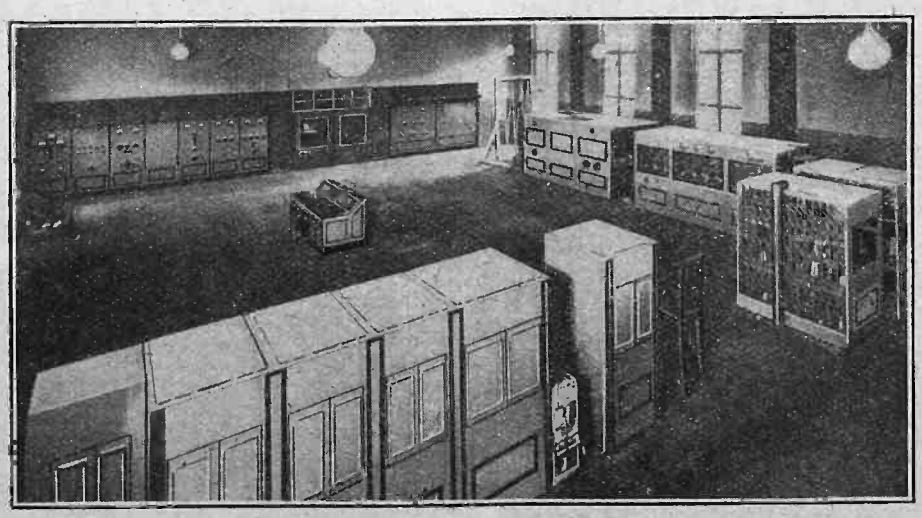
The Truth About Modern Music.

Modern music is perhaps easily assimilated by a world reared on Bach and Beethoven; but the B.B.C. is to do something towards "explaining" the newer school to listeners in a series entitled "New Friends in Music," starting next February.

oooo

Filling the Niche.

So the niche over the main entrance to "Broadcasting House" is to be filled with a group representing Ariel and Prospero in the famous scene in "The Tempest." The sculptor, Mr. Eric Gill, has a reputation for daring originality, and the new B.B.C. building should allow ample scope for exercising the gift



A GERMAN HIGH-POWER STATION.—There are interesting points of resemblance between the transmitting hall at Heilsberg, seen in the picture, and that of the B.B.C. station at Brookmans Park. Heilsberg, the second station of Germany's new high-power scheme, opened transmission on December 10th with a wavelength of 276 metres and a power of 75 kilowatts.

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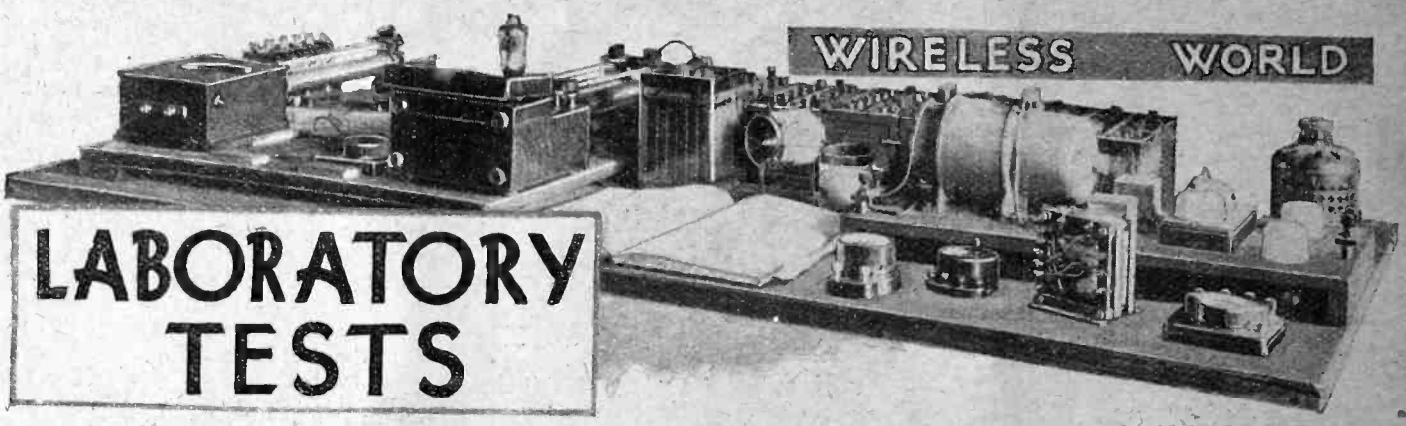


LABORATORY TESTS

A Review of Manufacturers' Recent Products.

TANNOY A.C. MAINS UNIT. Model C.P.2.

This unit combines an H.T. eliminator and an L.T. trickle charger in a metal container, the overall size of which is $9\frac{1}{2} \times 5\frac{1}{8} \times 3\frac{3}{4}$in. high. It will fit, therefore, in the space provided for the H.T. battery in the majority of portable sets. Its usefulness is not restricted to this one function, and it can be used as an external unit to supply H.T. to a cabinet-type receiver. Westinghouse rectifiers are fitted, a voltage doubling full-wave unit is employed for the H.T. supply, and a bridge-connected unit for the L.T. trickle charger, the latter giving 0.5 amp. max.

Three H.T. tappings are provided, two being variable and one fixed. The variable output voltages can be adjusted, in one case from 0 to 95 volts, and in the other from 0 to 120 volts, the maximum in each case depending on the load.

The fixed output was found to give 192 volts at 2 mA., 177 volts at 5 mA., 153 volts at 10 mA., 130 volts at 15 mA., and 106 volts at 20 mA. A small reduction occurs when a few milliamps are drawn from each of the variable tappings, the voltages from which are derived from potentiometers.

A practical test showed the unit to be entirely satisfactory provided the usual precautions have been taken in the set to

Tannoy A.C. mains H.T. eliminator and L.T. trickle charger.

counteract the detrimental effects of common resistance in the H.T. supply.

The makers are Tannoy Products, 1-7, Dalton Street, West Norwood, London, S.E.27, and the price is £5 10s.

FERRANTI CELL TESTER. TYPE C.T.2.

This instrument has been developed especially for cadmium tests of accumulators. This test enables the faulty ele-

Ferranti cell-testing meter designed especially for cadmium tests.

ment in a cell to be determined when voltage measurement and acid tests fail to definitely locate the trouble. In large batteries it is cheaper to replace the faulty element than to scrap the cell.

The cell under test should be charging or discharging at normal rate; on open circuit true reading will not be obtained. The cadmium electrode, which is encased in a perforated ebonite sleeve, clips on to the fixed pointed prod on the meter, and when lowered into the electrolyte enables true readings to be taken of the voltage between the acid and the positive, and acid and negative, plates.

The meter has a centre zero and two ranges: 3-0-3 and 0.3-0-0.3 volts, a switch bringing the desired range in operation. A fully charged cell shows, between cadmium and positive, 2.35 to 2.5 volts, and between cadmium and negative 0.1 to 0.2 volt, but on the opposite side of the zero, the difference being the true terminal voltage. This difference should correspond with the voltage given by the cell makers for a fully charged cell.

The meter can be used also as an ordinary centre-zero voltmeter.

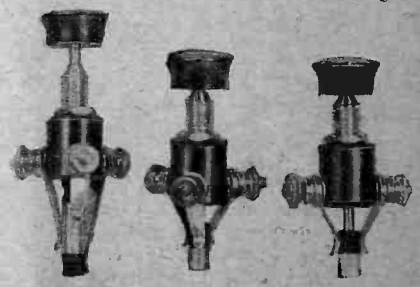
The makers are Messrs. Ferranti, Ltd., Hollinwood, Lancashire, and the price is 66s. 6d. The cadmium element is a separate item, and costs 5s. 6d.

oooo

"RED DIAMOND" SWITCHES.

The Jewel Pen Co., Ltd., 21-22, Great Sutton Street, London, E.C.1, have recently introduced three new types of push-pull switches. In each case the operating spindle and bush are insulated from the contact springs and collar so that the switches can be used on metal panels.

Type RD44, which is priced at 2s., is a single-pole double-throw switch designed



"Red Diamond" push-pull switches with insulated spindles. (Left to right) Types RD44, RD47 and RD49.

specially for gramophone pick-up connections. Here the isolated spindle is a distinct advantage, as it is essential to keep the capacity of the grid lead down, when the switch is called upon to deal with a change in grid bias.

Types RD47 and RD49 are specially designed respectively for the 1931 Ferranti "Battery Two" and "Screened Grid Three" kit sets. The RD47 is a three-contact switch for making and breaking the H.T. and L.T. circuits, and the RD49 a two-pole filament switch.

In all three types the action is positive and the contact springs are firm.

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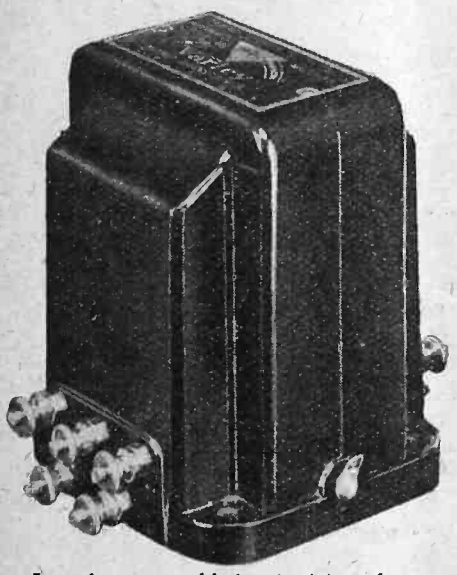
TWO NEW VARLEY COMPONENTS.

To facilitate the correct matching of the loud speaker and the output valves, Varley, 103, Kingsway, have introduced an output transformer which gives the choice of six ratios, namely 8 : 1, 10 : 1, 12 : 1, 15 : 1, 20 : 1, and 25 : 1. The D.C. resistance of the primary winding is 162 ohms, and its inductance 6.5 henrys when carrying 25 mA. of D.C. The primary is designed to carry 50 mA. of D.C. The overall dimensions of the components are 3½in. × 4in. × 3⅞in., and the weight is 2 lb. 12 oz. The price is £1 2s. 6d.



Impedance-matching output transformer by Varley.

A 3-henry L.F. choke with tappings giving 0.5, 1.0, 1.5, 2.0 and 3.0 henrys is another new addition to the Varley range. Its D.C. resistance was found to be 47 ohms. This component can be used, in conjunction with a large variable condenser and a resistance, in a tone control circuit in parallel with the anode impedance of one of the L.F. stages. Normally, it will not be required to

Varley 3-henry tapped L.F. choke.

carry the D.C. component of the anode current, consequently its dimensions are small, the overall size being 2¾in. × 1¾in. × 2⅞in., and the price is 8s. 6d.

NEW TUNEWELL PRODUCTS.

Tunewell H.F. choke, in which the sections are wound in alternate wide and narrow slots, and examples of new type push-pull switches. These components are made by Messrs. Turner and Co., Station Road, Old Southgate, London, N.11; the H.F. choke is priced at 6s. 6d., and the two- and three-point switches cost 1s. and 1s. 3d. respectively.

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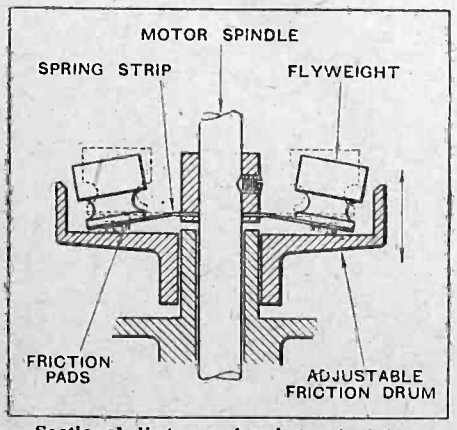
DIEHL "ARISTOCRAT" GRAMOPHONE MOTOR.

Designed exclusively for A.C. supply mains, this motor is of the induction type and is backed by the Singer Sewing Machine Co., of America. It is interesting to note that for some years this company has fitted induction motors of this type to its products with the object of



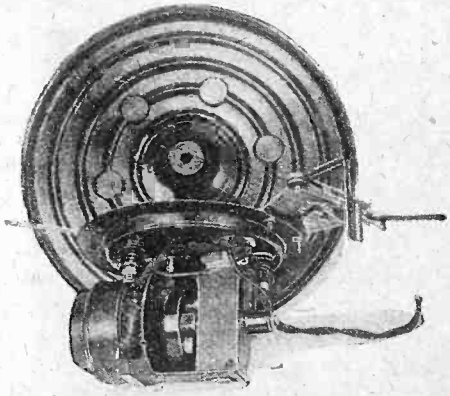
Sectional diagram showing principle of the Diehl governor mechanism.

eliminating interference with wireless receivers in the vicinity.

The motor is mounted horizontally and drives the vertical turntable spindle through a worm gear of conventional design. The governor, however, is unconventional from British standards and consists of two brass fly-weights mounted in a single spring strip at right angles to the motor spindle.

The motor plate is circular and the work of fitting to a cabinet is thereby considerably simplified. A three-point attachment is employed between the motor and its base plate, and each point is provided with coil springs and felt washers to absorb vibration. The turntable is moulded and its inertia is low so that the motor quickly attains its working speed. The centre hole is provided with cork bushes and the weight of the turntable is supported on a single-plate cork clutch. Thus protection is afforded to the worm gears, while sufficient friction is provided to drive the record against the resistance of the needle.

Tests were made on 230 volts A.C., and the current taken on load was 107 milliamps. A continuous run of two hours failed to show any signs of overheating,



Diehl "Aristocrat" induction motor and moulded turntable.

and at the end of this time a slight "grumble" in the governor mechanism, which was noticed at first, had disappeared, the friction pads having by this time been thoroughly bedded down.

The starting torque is good and the motor reaches its normal running speed in just over one complete revolution of the turntable. In the steady state the torque is satisfactory, and the speed is unaffected by large amplitudes in the record.

Messrs. Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1, are the distributors in this country, and the price complete is four guineas.

A quick make-and-break switch incorporated in an automatic stop is a standard item of the equipment.

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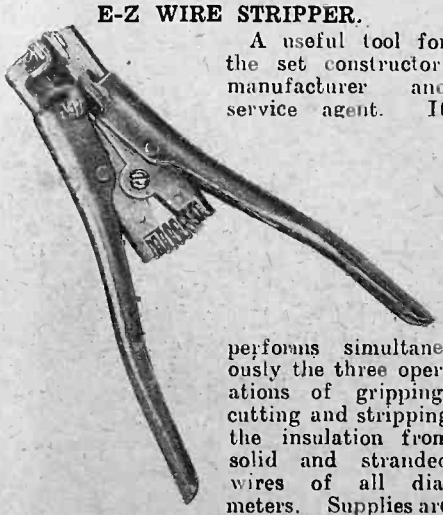
E-Z WIRE STRIPPER.



A useful tool for the set constructor, manufacturer and service agent. It performs simultaneously the three operations of gripping, cutting and stripping the insulation from solid and stranded wires of all diameters. Supplies are obtainable from J. B. Hyde and Co., Ltd. Broadheath, near Manchester, and the price is 15s. 6d.

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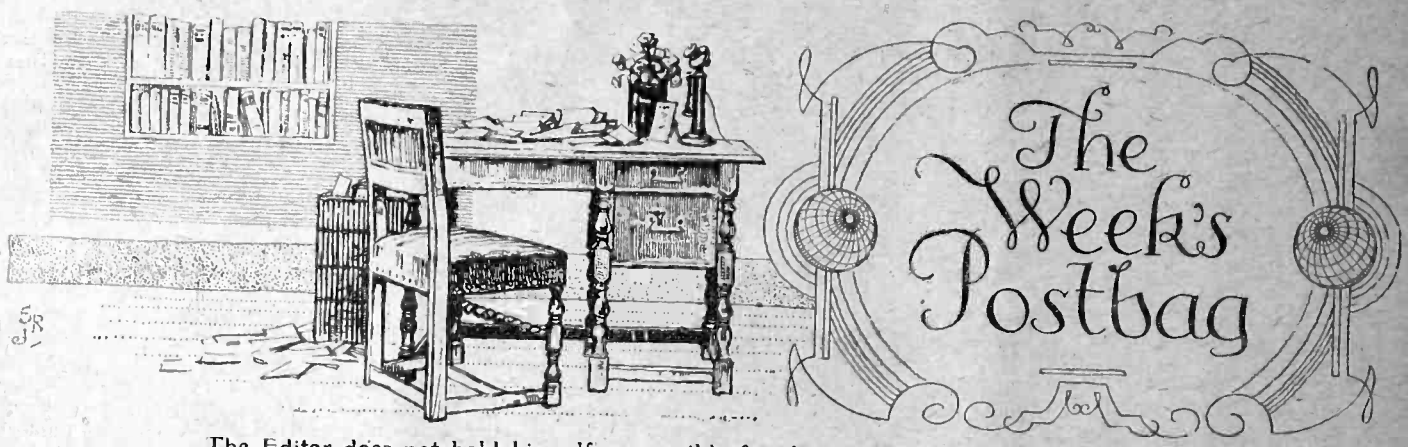

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

PENTODE v. TRIODE.

Sir,—In the article "Pentode v. Triode" (November 26th, 1930), reference is made to the sensitivity of a power valve in milliwatts per volt. This is somewhat in error, for sensitivity is actually measured in milliwatts per (volt)^2; the unit is thus independent of the actual grid input voltage, and one can fairly compare values of different power on the same basis. A unit in terms of milliwatts per volt is actually a mixture of sensitivity and output power, and therefore two valves which give the same output for a given particular input might have very different "sensitivity" merely because one happened to be rated at a higher power than the other.

Although the milliwatt per (volt)^2 unit is seldom referred to in print it is much used by designers in comparing valves, particularly pentodes with triodes. The only uncertainty lies in the unit of voltage. The tendency is to use the peak value in amplifier calculations, as this is more connected with other matters, such as bias, than the R.M.S. value; yet it seems to me to be inadvisable to adopt peak values unless specifically mentioned, as considerable confusion is liable to be caused when using the figures in connection with other electrical quantities.

London, S.E.3. M. G. SCROGGIE, B.Sc., A.M.I.E.E.,
Chief Engineer, Burndept Wireless (1928), Ltd.

LOUD SPEAKER EFFICIENCY.

Sir,—My attention is drawn to Mr. Barclay's article in your issue of December 3rd and to his statement that the efficiency of a loud speaker is less than 2 per cent.

I should be very glad to know how he arrives at this view. In the "acoustic tube" type of speaker developed by Dr. F. W. Lanchester and my firm it is possible to say with considerable accuracy what the output of energy in sound-waves is, and, as the same argument applies to the cone speaker and the sensitivity of the two is similar, I feel that it is possible to give the efficiency in set terms.

If Mr. Barclay were referring to the ratio of sound energy emitted to the dissipation of the valve, then I would not take much exception to his statement beyond saying that 4 per cent. was nearer the mark. But the instrument itself has an efficiency more nearly 33 per cent. R. H. PEARSALL,

Birmingham. Lanchester's Laboratories, Ltd.

Sir,—In reply to Mr. Pearsall, I cannot do better than refer him to the issue of *The Wireless World* for July 6th, 1927, which contains an article by Dr. McLachlan entitled "Loud Speaker Inefficiency—Sources of Energy Loss which Reduce Efficiency to 1 per cent."

Doubtless since the date of that article this figure has been somewhat improved, and I believe that in putting it on the average at 2 per cent. to-day I am not unduly wide of the mark. Indeed, if Mr. Pearsall will turn to an article on "Loud Speaker Performance" by E. J. Barnes, A.M.I.E.E., in *Experimental Wireless* of June, 1930, he will find the figure ascertained experimentally for the "absolute efficiency" of a cone of 7in. diameter in a flat baffle 3ft. square with moving coil drive. The conclusion may be quoted. "It was found that somewhat under half of one per cent. of the input was radiated as sound over the hemisphere facing the cone."

The discussion of loud speaker "efficiency" is gravely hampered by the lack of precise definition. It is, I think, somewhat misleading to speak of efficiency without any reference to the frequency-intensity characteristic. It is generally recognised that it is impossible to arrive at any set figure which will convey an idea of relative merit as between different loud speakers. In this connection, it is somewhat difficult to understand the figure of 33 per cent. which Mr. Pearsall puts forward for the efficiency of the product of his firm. One would like to have a precise definition of what constitutes the efficiency of "the instrument itself," which reaches this highly attractive figure.

Arcadia, Bieldside, N.B. W. A. BARCLAY.

SERVICE.

Sir,—Your recent editorial on servicing, and letters called forth from readers on the same subject, have been of outstanding interest, not only to retailers, but to the average reader. The all-important matter of servicing calls for a really high standard of technical knowledge and experience, and while some traders themselves have thoroughly gone into the technical side of the radio art there yet remain a great majority who have not considered this a worth-while matter. Too often they rely on the practical experience of their employees to carry them through the difficult part of after-sales work, and this is regrettable if for no other reason than good service makes good sales. As a branch service manager of a very large radio manufacturing firm, I could give innumerable cases of adequate service bringing a very rich reward indeed, while, on the other hand, indifference to customers' wishes has brought the eternal grouse of poor sales.

My contention is that where a trader is thoroughly interested in the sale of radio products, servicing becomes second nature to him, and, if the trader himself has no time to study this subject, he will invariably pick out a thoroughly competent engineer to look after this side of his business.

In your editorial of October 22nd you indicated that "Those who join the ranks of the service man on the merits of technical knowledge and training alone should also have some recognised certificate of competence to give confidence to the public." This very important matter was in the minds of a number of radio engineers who, during recent months, have inaugurated a scientific body known as "The British Radio Institution." It is the aim of this society to standardise technical and practical knowledge of all subjects appertaining to the radio art—and this by examination and examination only. It is hoped by this method to embrace those workers ashore and afloat who have made wireless their profession, both in applied radio and its kindred subjects of power speaker equipment and talkies. Our examination covers this extensive field of knowledge, and it will be the aim of the B.R.I. to so maintain a standard of knowledge that whenever a radio engineer indicates associateship with the

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B.R.I. his qualifications in the radio art will be unquestionable. This institution, therefore, very closely meets with the scheme put forward by you two months ago, whereby traders and radio engineers will have a basis of qualification, and in view of this sympathy of ideals, Mr. Editor, may I ask you to bring the activities of the British Radio Institution to the notice of your many readers through the medium of your correspondence columns?

D. H. IRVING,
Secretary, British Radio Institution.

Bristol.

GRAMOPHONE MOTORS.

Sir,—Following a recent note on the Garrard Induction Motor for gramophones, your readers may be interested to know that, although primarily designed for 40-60 cycle supply, it can be made to work satisfactorily on higher frequencies.

I obtained one of these motors, and wished to use it temporarily on 90 ~ 200 v. (pending the alteration of my supply to 50 ~ next year). The windings are in two parts, which can be connected in series for 200-250 v., or in parallel for 100-130 v. The windings were connected in parallel (marked "100-130 v., 40-60 ~ ") and supplied with 50 ~ 120 v., and the current taken was noted. (There was some difficulty in finding an ammeter with a low enough range, but finally a 0-250 mA. hot-wire meter was borrowed; it read 0.175 amp., which is probably inaccurate, but we may assume that the same point on the scale indicates the same current at 90 ~ and at 50 ~.) The 100-volt winding was then supplied through a series resistance from 200 v. 90 ~ and it was found that if the series resistance was about 350 ohms the current was the same as in the first case (0.175 amp. nominal). (It is interesting to note that in each experiment the rotation was stopped by holding the turn-table; the increase of current was too small to read.)

It is found that a 100-volt 32 c.p. carbon filament lamp is exactly right used as a series resistance, with the 100-volt windings on 200 v. 90 ~. The motor was run continuously for two hours in this way; the windings were only slightly warm, and the (unwound) rotor was cool enough to bear the hand on with comfort. It does not slow up, with this arrangement, on heavy passages in the record. Used with a Marconiphone pick-up and a powerful amplifier (AC/HL, AC/P, two LS6As in push-pull, all resistance-coupled except power stage), bad A.C. hum was noted, even before switching on the motor. This was chiefly due to the potentiometer volume control mounted near the pick-up; screening with a tobacco tin, and using lead-covered wire (connected to screen and earthed on covering), made a great improvement, especially when the current to motor was taken in lead-covered and earthed wire. The last traces of hum were completely removed when the body of the motor itself was earthed (by one of the holding-down screws).

Anyone having a higher frequency supply than 60 ~ may be interested to know of the possibilities of using an induction-type motor; in general, it may be expected to be more satisfactory than a "Universal" type, since the latter employ brushes and a commutator, which are generally troublesome to keep in order, even with machines of several horse-power, and more so with such very small sizes as are required to drive a gramophone.

C. R. COSENS.

Cambridge.

NEWCASTLE TRANSMISSIONS.

Sir,—I write to you on the subject of the B.B.C. transmission from Newcastle in the hope that you may see fit to deal with the subject editorially, and, also, that the publicity which *The Wireless World* provides will secure at an early date some improvement in the conditions under which local broadcast licensees receive the B.B.C. programmes. There are perhaps two aspects of the matter, namely, quality and choice of programme.

As regards quality, I should first say that my own receiver is situated some two miles from the transmitter, and is, though of course not perfect, I think, of adequate goodness to enable one to form a proper judgment. It consists of a band-pass filter feeding an H.F. stage which is coupled by a straight-forward transformer to a detector. There is then a resistance-capacity stage of L.F. followed by push-pull output incorporating LS5A valves with 445 volts at the anodes. A moving-coil speaker is used, and there is a milliammeter in each anode feed. All stages are decoupled, and there is practically no trace of hum, even at full power. There are nine valves in all, five in the receiver proper, two half-wave rectifiers for the output stage, one full wave for the earlier stages, and another for the speaker field.

Now, it is noticed that, while there are times when reproduction is as good as the receiver is capable of providing, there are more times when the background noises so mutilate the transmission as to make listening almost impossible. Part of this is due, I understand, to land-line noises and part to the radio link which is employed at those periods of the day when the Post Office do not supply the B.B.C. with land-lines. Not only does the local listener have his programmes interfered with by noises, but not infrequently does the transmission get cut off entirely. (On the evening of December 8th, for instance, there was a cut-off for several seconds at 7.56 p.m. and again at 8.25 p.m.)

Now I admit that probably the only argument a local listener has is the poor one that he pays the same fee as his co-listeners near London, who have a local station which is capable of transmitting programmes which do not suffer from the defects I have mentioned, but I still think that the conditions here are such as to warrant considerable improvement. They were far better, for instance, when Newcastle had its exclusive wavelength and could radiate its own programmes.

I turn now to the question of choice of programme. There is no alternative station available, for Newcastle radiates for the most part the National programme, which is about the only other programme that can be reached by the average receiver, i.e., from Daventry 5XX. Even when the new twin station at Moorside Edge starts its operations, Newcastle will in all probability be no better off, for it will be outside the guaranteed service area. (See B.B.C. Year Book, 1931, p. 268), and even the retention of the Newcastle transmitter will presumably mean the duplication of one or other of the programmes.

I, therefore, suggest that Newcastle be given again an exclusive wavelength. It could take over the frequency of 1,013 kc., about 295 metres, at present—according to *World Radio*—not allotted, and which would give the standard separation of 9 kilocycles from the nearest allotted wavelength. If this were done, and Newcastle allowed to produce its own programmes, considerable improvement would be effected, and the many thousands of listeners in the densely populated area of Newcastle and the large district with which it is surrounded would be able to receive programmes which were not adulterated with the unpleasant rumblings, etc., to which they for some time have been obliged to submit, if they wanted to listen at all.

I have little or nothing to say as regards the programmes themselves. The task of preparing programmes day after day for so many stations is an immense feat in itself, and it is clearly impossible to provide every listener every day with everything he wants most. I would, however, suggest, as others have done before, that more variety, or at least alternatives, be given on Sundays. Those whose tastes lean towards pious meditation or ecclesiastical music till 9 p.m. on a Sunday evening surely would not deny their equally sincere brethren music of a lighter character. By all means let us have education (in addition to entertainment), but why coercion?

I would further say that it seems that the time has arrived when the timing of evening programmes generally might be altered. The evening programme might begin at 7 p.m. instead of 7.45, when probably the majority of listeners are eating. The time-table might run then as follows :—7-8 ; 8.15-9.15 ; 9.30-11.30, with the intervals either silent or for news. At present the programme from 3.45 is like a patchwork quilt :—3.45-4.45 ; 4.45-5.15 ; 5.15-6 ; 6-6.15, etc.

QUALITAS.

Jesmond, Newcastle-on-Tyne.

RE *BROADCASTING GRAMOPHONE RECORDS.*

Sir,—As one who is interested in all remarks under the above heading, I consider that the arguments for and against about balance out. I do, however, consider that your correspondents have entirely overlooked the most important argument against gramophone broadcasts, namely, the apparent lack on the part of the B.B.C. of appreciation of the necessity of keeping constant turntable speed. Surely the chronic speed variation of the machine used by the London Regional at lunch time on December 10th was apparent to the most uninitiated ear. Really

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good recording was absolutely wasted, whilst the entertainment value of the programme was negatived.

Forest Gate, E.7. L. S. DEIGHTON.

Sir,—My attention has been drawn to a letter written by Mr. Chestney in your issue of December 10th, dealing with the psychological effect on the radio listener of the broadcasting of gramophone records. I do not believe that a judicious increase in the number of records broadcast by the B.B.C. would lose them a single licence-holder besides Mr. Chestney himself.

The very considerable correspondence which I get from listeners leads me to suppose that in the present state of programme-building such as the B.B.C. can afford, more rather than less broadcasting of records is desired, even when no illusion is intended. Where, however, the fact that records are being used is not emphasised, or has even been camouflaged, the improved efficiency of the performance would probably induce even Mr. Chestney to keep his licence going, and if or when the B.B.C. begins to make its own recording of complete programmes, we may hope for a palinode from him.

London, W.1. CHRISTOPHER STONE.

The Gramophone.

REACTION AND THE BAND-PASS FILTER.

Sir,—May I suggest to Mr. Cocking that his approximate formula (2) on page 642 for the voltage magnification of a capacitatively coupled filter at peak frequency would be rendered more accurate as well as simplified were it written:

$$\frac{e}{E} = \frac{1}{2R\omega C}$$

This result is obtained by differentiating the standard formula for $\frac{e}{E}$ with respect to $\left(\omega L - \frac{1}{\omega C}\right)$, on the assumption that $\frac{1}{\omega C_m}$ is constant over the peak width of the tuning band.

N.B. W. A. BARCLAY.

PHILIPS RECTIFIERS.

Interesting Range of High-vacuum and Gas-filled Types.

THE full range of rectifying valves made by Philips Lamps, Ltd., Philips House, 145, Charing Cross Road, London, W.C.2, includes over 100 different types which may be divided broadly into three classes, namely, high-voltage rectifiers suitable for use in wireless transmitters, gas-filled rectifiers for charging high- and low-tension accumulators, and high-vacuum types intended for use in H.T. battery eliminators. Those comprising the last-mentioned class are designed to operate at filament voltages for which suitable transformers are readily available.

The majority of these valves are fitted with 4-volt filaments and consume from 0.6 amp. to 2 amps., according to type. In the following list we give briefly the essential information with regard to those valves particularly suited for use in A.C. receivers and H.T. battery eliminators.

PHILIPS H.T. HIGH-VACUUM RECTIFIERS.

Type.	Maximum A.C. Anode volts.	Maximum rectified current.	Half- or Full-wave.	Filament voltage.	Filament current.	Price.
373	220	40 mA.	Half-wave	4.0	1.0	15/-
505	400	60 ,,	,,	4.0	1.0	15/-
1562	750	110 ,,	,,	7.5	1.25	30/-
1801	220 × 2	30 ,,	Full-wave	4.0	0.6	15/-
1821	250 × 2	60 ,,	,,	4.0	1.0	17/6
506K	300 × 2	75 ,,	,,	4.0	1.0	20/-
506	375 × 2	60 ,,	,,	4.0	1.0	20/-
1560	300 × 2	125 ,,	,,	5.0	2.0	22/6
1561	500 × 2	120 ,,	,,	4.0	2.0	22/6

Another group which has a special application in the radio sphere is the gas-filled types developed for charging high- and low-tension batteries. Philips gas-filled thermionic rectifiers are fitted with a barium-oxide coated filament, which confers the advantages of low filament consumption and low filament temperature. Consequently a small bulb can be used, rendering the rectifier easily accommodated in a restricted space.

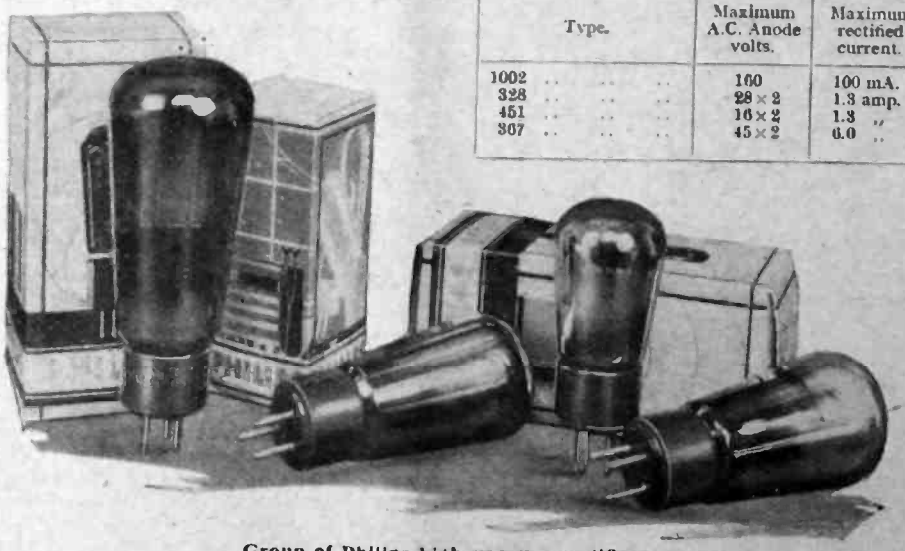
The most interesting valves in this class will be found in the following table:—

PHILIPS GAS-FILLED RECTIFIERS FOR H.T. AND L.T. CHARGES.

Type.	Maximum A.C. Anode volts.	Maximum rectified current.	Half- or Full-wave.	Filament voltage.	Filament current.	Price.
1002	160	100 mA.	Half-wave	1.8	2.8	15/-
328	28 × 2	1.3 amp.	Full-wave	1.8	2.0	12/6
451	16 × 2	1.3 ,,	,,	1.8	2.8	12/6
307	45 × 2	6.0 ,,	,,	1.8	8.0	25/-

A very useful appendage to these gas-filled rectifiers is the Philips regulator lamp, the function of which is to maintain the current at a constant level even though the voltage varies within quite wide limits. The charging current depends upon the difference between the voltage of the battery and that of rectified voltage delivered by the valve. With a 2-volt cell, for example, this difference will be relatively large as compared with the case when a 6-volt battery is connected to an L.T. charger, and in the former case a current-regulating resistance must be used.

The resistance of these regulating lamps depends upon the temperature of the wire, the resistance increasing as the temperature rises. Thus, within certain limits the current through the device remains at a constant value. These regulating lamps can be obtained to suit the majority of gas-filled rectifiers listed. The correct lamp for the 328 rectifier is type No. 329, with a limiting factor of 1.3 amp. and with the 1002 rectifier lamp No. 1003 should be used, which maintains the current between 60 and 90 mA. for any battery voltage from 40 to 120.



Group of Philips high-vacuum rectifiers.

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READERS' PROBLEMS

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Safety Fuses.

Due to the fact that the H.T. battery failed suddenly, I have just fitted a flashlamp fuse between the negative H.T. and L.T. terminals of my "Band Pass Three" receiver. It is now noticed that the lamp glows quite brightly when the high-tension battery is connected; does this indicate that there is still a short-circuit, and, if so, which is the most likely place to find it?

If your flashlamp bulb is of the low-consumption variety, it is quite possible that its filament will be heated to incandescence by the flow of charging current to the by-pass condensers which are included in this receiver. If the flash is of momentary duration, you can rest assured that all is probably in order, and that the original short-circuit, if indeed it ever existed, must have cleared itself.

On the other hand, if the lamp glows continuously there must clearly be a fault, which may possibly be attributed to a defective by-pass condenser. If these components are proved to be beyond suspicion, your attention should be transferred to the H.F. transformer, as there may be a short-circuit between its primary and secondary windings.

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Bias Resistance Values.

With reference to the Valve Data supplement included with "The Wireless World" for November 26, will you please tell me if it is in order to use the anode currents given there as a basis for calculating the values of automatic bias resistance?

Yes, the information given with regard to average anode current may certainly be used when making these calculations, as it is correct with regard to normal specimens used under amplifying conditions. In dealing with abnormal valves, or with valves used in an abnormal manner, the only way of ensuring extreme accuracy is to make an actual measurement.

It may be pointed out that many automatic bias circuits are to a great extent self-regulating, and in consequence it is seldom vitally necessary to choose exactly the right value of resistance.

Obsolete Valves as Power Rectifiers.

I have a large number of obsolete bright-emitter valves which I should like to use in place of my double-wave rectifying valve, which has just failed. Will you please show me how to make the necessary alterations to the eliminator (the circuit diagram of which I am sending you), and also say if these old valves should be capable of supplying 25 milliamps. at about 160 volts?

We assume that you wish to use two of the bright-emitter valves as full-wave rectifiers. This plan should be fairly satisfactory, and the alterations to your eliminator—of which the rectifying section is reproduced in Fig. 1 (*a*)—should be made on the lines suggested in diagram (*b*). You will observe that plate and grid terminals of each valve are connected together. The filament-heating winding of your transformer should be capable of delivering between 4 and 5 volts at about 1.5 amp.

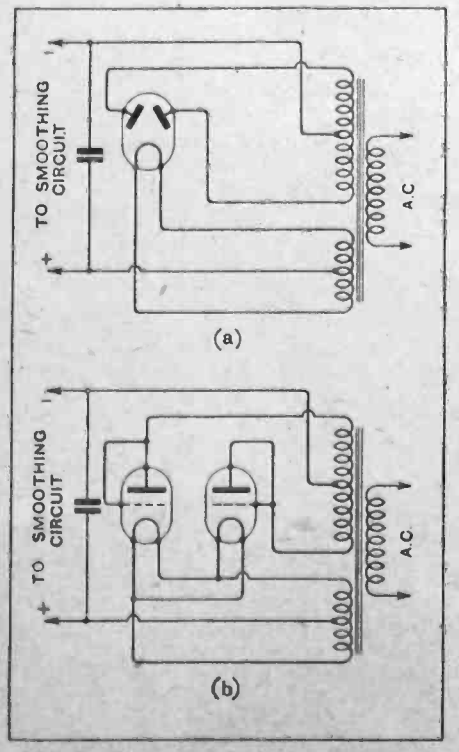

Fig. 1.—Diagram (a) shows the conventional circuit arrangement for a full-wave valve rectifier; two triodes, with plates and grids joined together, may be substituted in the manner shown in diagram (b).

Provided that the H.T. secondary of your transformer gives an A.C. voltage in the order of 250 R.M.S., there should be no difficulty in obtaining the output you require, but it must be realised that regulation will not be so good as when a proper rectifier is used.

oooo

"Half a Loaf . . ."

Do you consider that an input band-pass filter may be satisfactorily operated if its circuits are tuned by separate variable condensers? Although my own condensers are fitted with spindle extensions, they are not of the type that is generally recommended nowadays for ganging purposes.

We would strongly dissuade you from attempting to tune your filter circuits by means of independent condensers. Experience shows that it is extremely difficult to operate a set of this type if coupling is sufficiently close to give proper band-pass or double-humped tuning. Even if your present condensers are so unsuitable that single-dial control can only be maintained perfectly over a few degrees, it would be better to link them together mechanically—with, of course, some provision for compensation—rather than operate them separately.

oooo

A.C. Valves as Detectors.

I am about to fit indirectly heated A.C. valves in my two-valve det.-L.F. receiver. As it will no longer be possible to obtain positive bias for the detector by connecting the grid leak to L.T. positive, would it be worth while to fit a bias cell?

The average A.C. valve of the type likely to be used as a rectifier has such characteristics that it is quite unnecessary to provide bias for a grid detector, as grid current in these valves usually starts to flow before the grid is made positive with respect to the cathode.

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"Power Pentode Two" Tuning Arrangements.

I am about to rebuild my "Power Pentode Two" in a larger cabinet, and at the same time should like to fit a band-pass filter. If this is practicable, will you please give me a circuit diagram showing the necessary alterations, and also say where I can find a published description of suitable coils? It is intended to use a differential condenser as an input volume control device.

As the "Power Pentode Two" normally covers only the medium broadcast band, we take it that long-wave reception is not desired, and the circuit diagram given in Fig. 2 is prepared on this assumption.

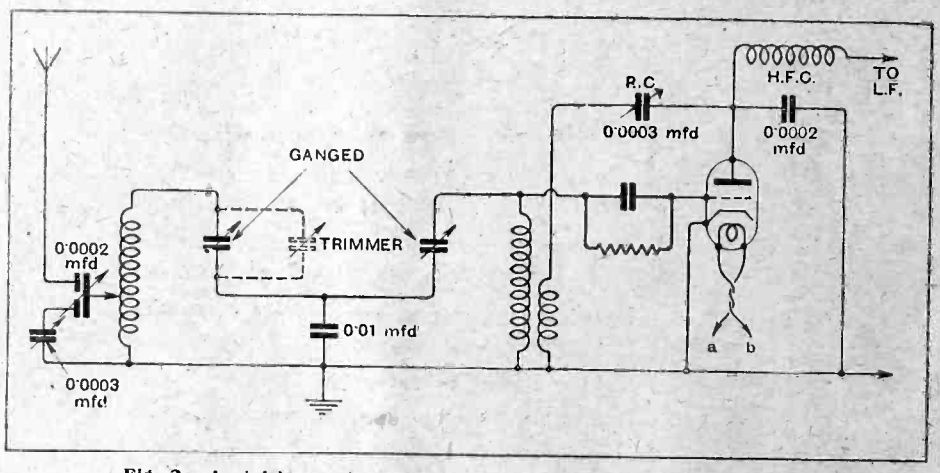

Fig. 2.—Aerial input circuit of the "Power Pentode Two," modified for band-pass tuning.

Regarding the coils and condensers for the filter circuit, you may be guided by the description of the components used in the "Band Pass Unit" described in our issue for August 27th, 1930.

A differential condenser will be suitable as an input volume control device, but we recommend you to use, in conjunction with it, a semi-variable balancing condenser, so that tuning need not be unduly affected. This condenser is shown in our diagram.

oooo

Doubtful Economy.

To save space, I have been thinking of using tuned-anode couplings for the two H.F. stages of a projected self-contained battery-operated receiver with screen-grid valves. I am aware that the prevention of interaction becomes more difficult when this form of H.F. coupling is used, but am quite prepared to fit decoupling devices for each circuit. Will you please give me a word of advice?

In spite of the fact that several very successful portable sets employ the tuned-anode system, we think that you would probably save yourself much experimental work by using either the tuned grid or transformer method of H.F. coupling.

Although you may be prepared to take the fullest possible precautions, it must not be forgotten that the inclusion of decoupling resistances of high value will bring about a commensurate loss of H.T. voltage, which can seldom be spared in a battery-fed receiver of the self-contained type.

oooo

The Cathode Connection.

The power transformer of my eliminator is fitted with a spare centre-tapped secondary winding giving a rated output of 6 volts, and intended for heating the filament of the last L.F. valve of a receiver. It is my intention to take advantage of this source of supply, and to fit a P.625 in place of my present 2-volt output valve. To what point should the centre tapping be connected?

The centre tapping of this filament winding must be regarded as the cathode connection of the output valve. Unless some form of automatic bias is used, the tap will be joined directly to the common H.T.-L.T. negative bus-bar.

oooo

Filament Current Meter.

An ammeter is permanently connected in series with the filament circuit of my D.C. mains receiver; it normally shows a reading of 0.25 amp. I am puzzled by the fact that, when self-oscillation is produced by operation of the reaction control, a momentary "flicker" of the meter needle is produced, and its steady reading is slightly changed. As oscillatory currents should be confined to plate and grid circuits, I am at a loss to see how the filament circuit can be affected. Will you please explain this effect?

In a receiver fed entirely from D.C. mains, it is quite usual that the filament current meter should be connected in such a way that it indicates any change in anode current—such as the change produced when a valve passes from the non-oscillating to the oscillating condition.

If it is desired that the meter should register filament current only, and be unaffected by changes in anode current, it should be transferred to between the mains input and the positive filament terminal of the output valve.

Artificial Loading.

I have an L.T. transformer, rated at 4 volts, 4 amp., and propose to use it temporarily for feeding the heaters of two A.C. valves, consuming a total of only 2 amps. Under these conditions, I believe that the voltage output of the transformer is likely to exceed its rating, with the consequence that the valves may be slightly overrun. In any case, it will be necessary to connect a potentiometer across this winding; would it not be possible to prevent any rise in voltage by using a potentiometer of exceptionally low value, thus imposing an artificial load?

Although the rise in voltage across the secondary of a well-regulated transformer should not be excessive when operating under the conditions you describe, no harm would be done by using a low-resistance potentiometer. A value of 2 ohms would be correct, and you should take care to see that it will carry a current of 2 amperes without undue heating.

oooo

Unscreened Condensers.

In the construction of a "2-H.F." receiver to be operated with a frame aerial, it is intended to use separate screens for each of the H.F. inter-valve coupling coils; will it be necessary to provide screening for the tuning condensers as well?

If high-stage gains are aimed at, it will be wise to screen the condensers, as otherwise instability may be caused by interaction between them (or their exposed wiring) and the frame. Experience shows that total enclosure in a screening metal container is a desirable condition.

FOREIGN BROADCAST GUIDE.

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(Algeria, North Africa).

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Wavelength: 363.4 m. Frequency: 825.3 kc. Power: 13 kW.

Time: Greenwich Mean Time.*

Standard Daily Transmissions.

12.30 G.M.T., gramophone records; 18.00, oriental concert (Fri.); 19.00, news bulletin, concert; 21.00, oriental concert (Tues); 22.30, dance music or relay of cabaret.

Male announcer. Call: *Ici Radio P.T.T. Alger du Gouvernement Général.*

Announcements are sometimes made in both French and Arabic.

Occasional Interval signals: Gong.

Closes down with *La Marseillaise* and usual good-night greetings in French.

*** Algeria does not adopt Summer Time when the change-over is made in France.**

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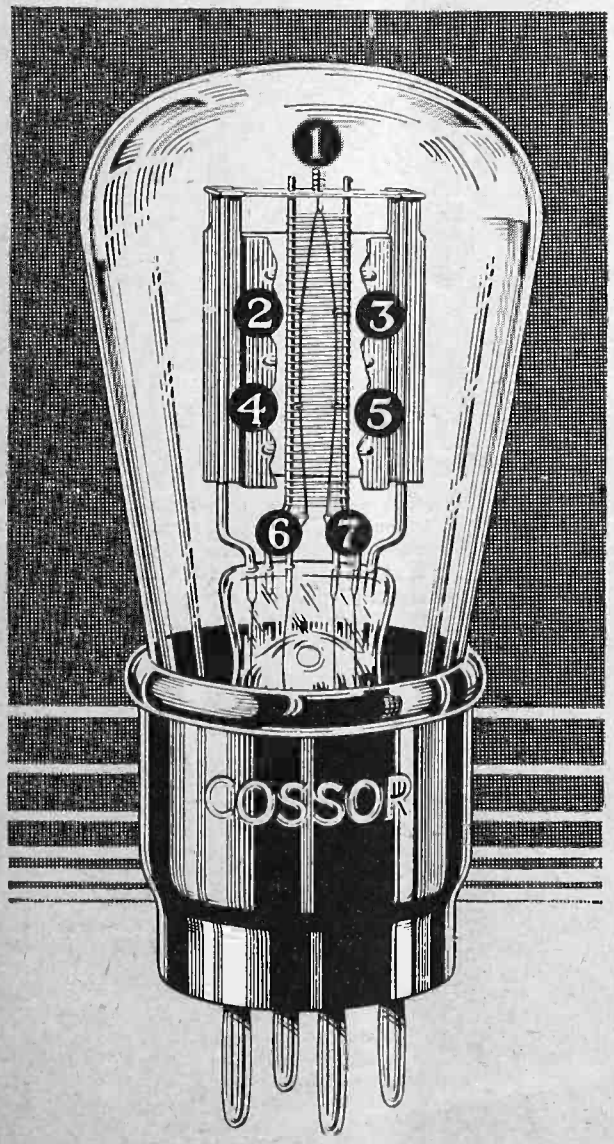
—by eliminating filament vibration



Microphonic noises in a Receiving Set are usually traceable to the Detector Valve. Nine times out of ten the cause is filament vibration. Look at the illustration alongside. This shows the internal construction of the new Cossor Detector Valve. See how the filament is held—not only top and bottom—but also by four insulated hooks spaced at intervals throughout its length. The purpose of these hooks is to damp out any tendency for filament vibration. Therefore by using this "steep slope" Cossor Detector Valve in your Receiver the possibility of microphonic noises is definitely eliminated and you are assured of greater volume with absolute tonal purity.

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W.W.3.

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W.W.94.

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EPOCH.—The amazing model 101 (Domino).

EPOCH.—If you have not, take the first opportunity of doing so.

EPOCH.—The amazing model 101 (Domino).

EPOCH.—No matter what loud-speaker you have heard, your decision will be firm.

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EPOCH.—The amazing model 101 (Domino).

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EPOCH.—The amazing model 101 (Domino).

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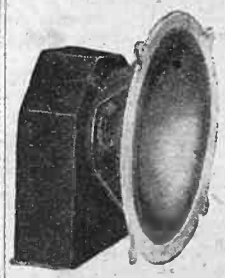

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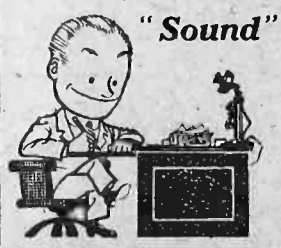

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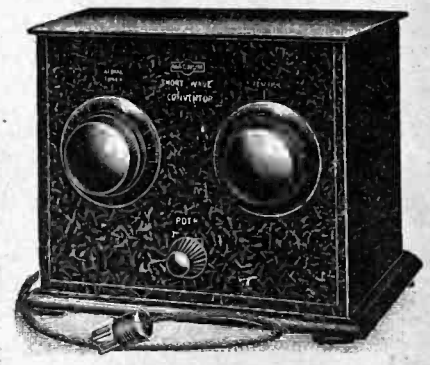

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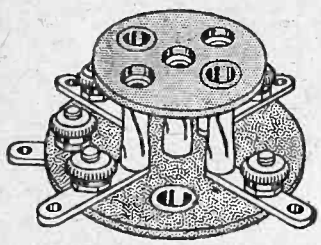

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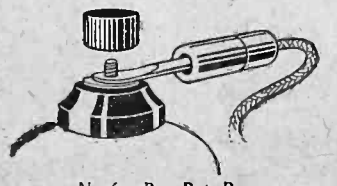

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How many H.T. batteries have you discarded long before they have given their whole life, because they starve your valves and give disappointing results? The installation of C.A.V. rechargeable H.T. Accumulators will alter all that.

They are constant throughout the charge, cost little to recharge, and last for years.

They are the safest and purest form of H.T. supply; with no fear of a dangerous shock, and they operate with a total absence of noise, hum and crackling as a background to your broadcast.

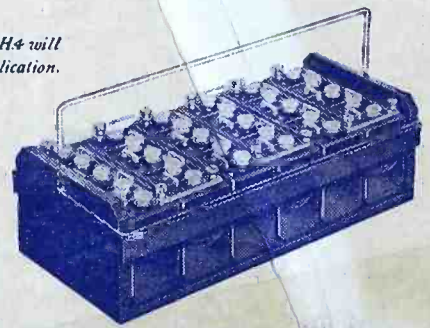
Let C.A.V. give you purer, better and cheaper radio.

Radio Battery Catalogue No.H4 will gladly be forwarded upon application.

M105 10-Volts 10,000 Milliamps 12/-

M103 10-Volts 5,000 Milliamps 6/3

M101 10-Volts 2,500 Milliamps 5/-



M603 60-volt, 5,000 Milliamps Group in Crate. Price £2-5-0

C.A.Vandervell & Co. Ltd.
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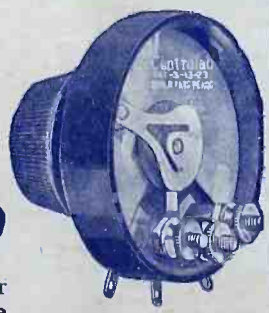
When it's a Question of Control Specify Centralab



Centralab Potentiometer type Volume Controls are used as standard equipment by the leading radio set manufacturers throughout the world. The Centralab sliding shoe contact definitely ensures noiseless and perfectly smooth control from a whisper to maximum volume. When it's a question of control, you cannot go wrong if you specify Centralab.

Write for the Centralab Catalogue—it's Free.

TYPE	RESISTANCE
P.109	0-200 ohms.
P.110	0-400 ,,
P.111	0-2,000 ,,
P.112	0-10,000 ,,
P.050	0-50,000 ,,
P.100	0-100,000 ,,
M.250	0-250,000 ,,
M.500	0-500,000 ,,

ALL MODELS 10/6

THE ROTHERMEL CORPORATION LTD.,
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'Phone: MAYFAIR 0578/9.
Continental Sales Office: 27, QUAI DU COMMERCE, BRUSSELS, BELGIUM.

DO YOU SEE THE POINT AND NOTE HOW IT FITS

PATENT

The patented LISENIN Wander Plug illustrated is designed to overcome all H.T. battery troubles. It is constructed to allow for the annoying variations found in battery sockets of all makes. Having a two point contact it effectually overcomes all wobble troubles and it will not jolt out. Of course it embodies the well-known and ever popular LISENIN PATENTED POSITIVE CONE GRIP.

Supplied in seven colours—red, black, green, blue, mahoganite, yellow and white.

PRICE 2d. each.

POSITIVE GRIP Plugs and Sockets, 4d. each.

POSITIVE GRIP Spade Ends, 3d. each.

POSITIVE GRIP Pin Ends, 2d. each.

STOCKED BY ALL RADIO DEALERS. Refuse substitutes.

Sole Manufacturers and Patentees:
The LISENIN WIRELESS Co.,
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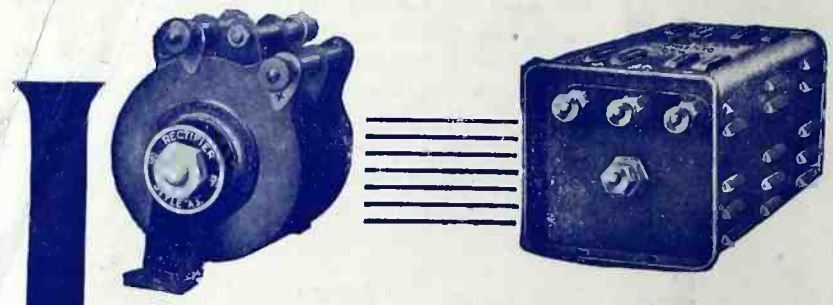

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This Rectifier affords by far the most convenient, reliable and economical means of rectification yet discovered. It is all metal, containing no moving parts, valves or chemicals, so that there is nothing to wear out or require periodical attention.

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